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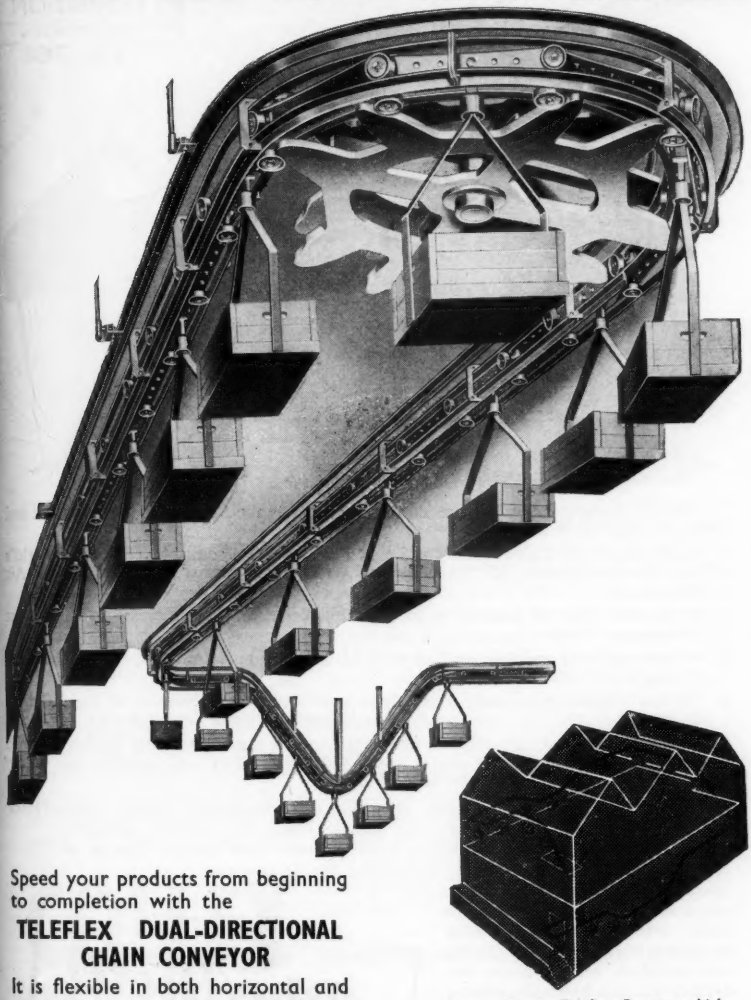

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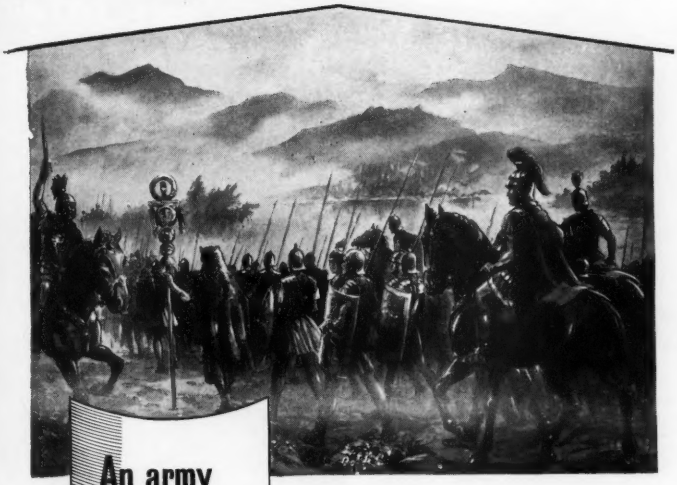

An army that disappeared

In the Spring of 217 B.C., Hannibal, the Carthaginian Commander, crossed the Alps and invaded Italy. He defeated a great Roman Army at Trebia, leaving a hard-pressed Senate to defend a threatened Rome. With considerable difficulty they raised a further 40,000 men and despatched them under the Consul Flaminius to drive off the Carthaginians. Their choice of a commander was unfortunate, for Flaminius was a hot-blooded, impetuous man of little military ability. To draw him to a battleground of his own choosing, Hannibal after burning and wasting Umbria, then retired along the narrow shore of Lake Trasimenus, dropping off picked divisions into the surrounding hills to outflank the pursuing legions and block their advance. Furious at this ravaging on Roman soil, Flaminius rushed after the Carthaginians. The Romans, in column-of-march, were soon in the trap, and Hannibal's troops, who had been concealed by the dense morning mists and high hills, rushed down and destroyed them. An army of 40,000 men who had marched off along the quiet lakeside into the mist, had *vanished without trace* ere nightfall . . . . . .

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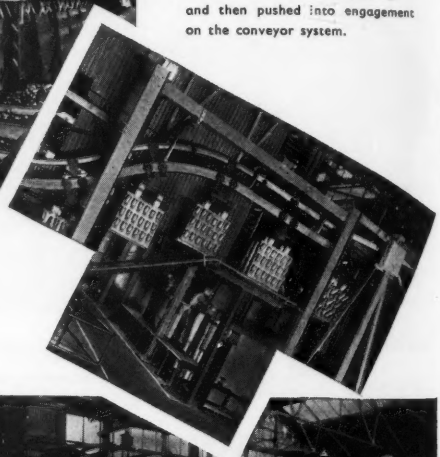
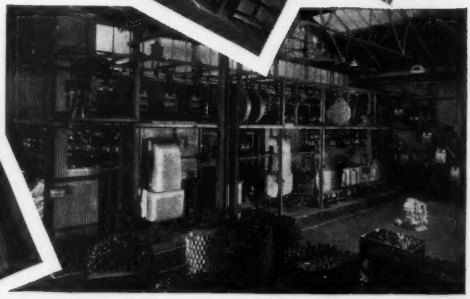
Photograph left:
Trolleys with empty carrier plates are automatically delivered to the free track for loading with fittings and then pushed into engagement on the conveyor system.



Photographs right:
Views of loaded carrier plates progressing towards and through the process section of the conveyor, where they are automatically degreased, rinsed, phosphate coated, dried, varnished and stoved.

Photograph below:
Illustrates continuous electrostatic paint spraying on to fittings prior to entering oil-fired, air circulated, stoving oven.



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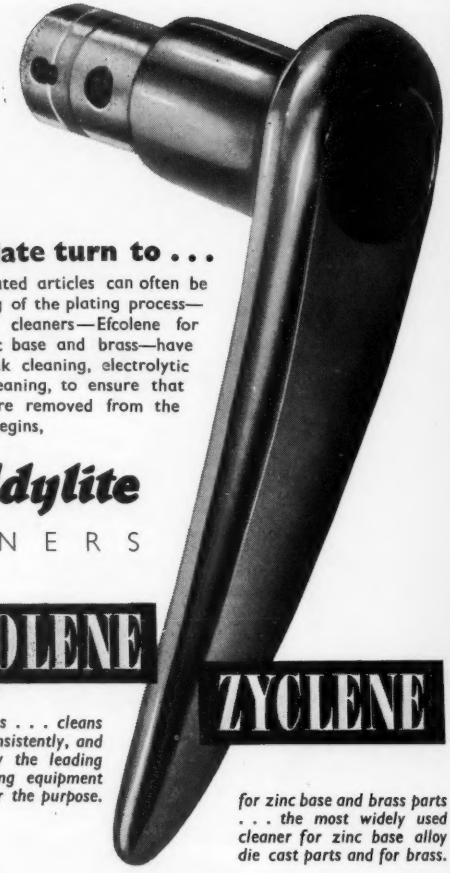

before you plate turn to . . .

The cause of badly plated articles can often be traced to the beginning of the plating process—cleaning. Efco-Udylite cleaners—Efcolene for steel, Zyclene for zinc base and brass—have been developed for soak cleaning, electrolytic cleaning and barrel cleaning, to ensure that all grease and soil are removed from the metal before plating begins,

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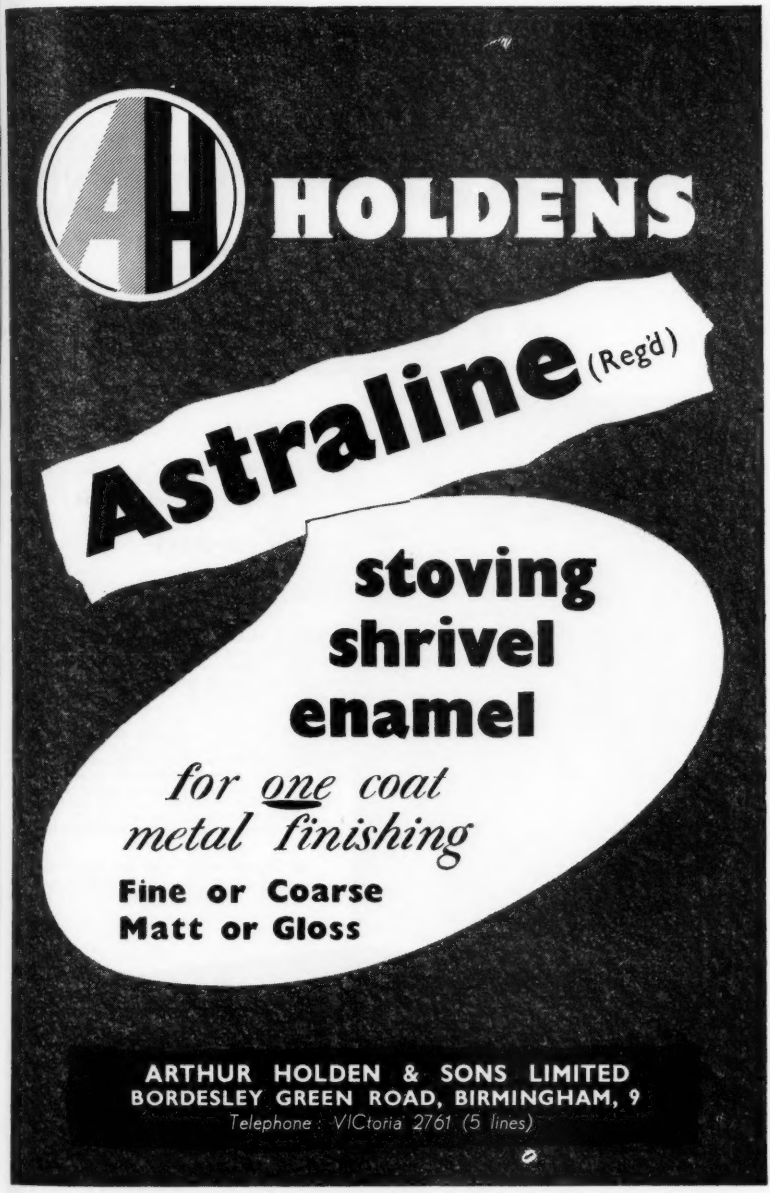
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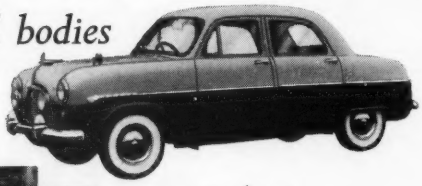

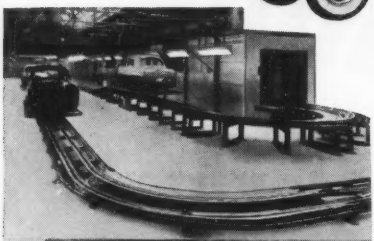

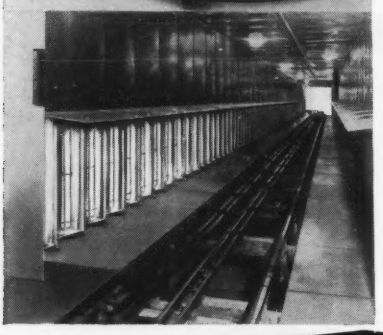

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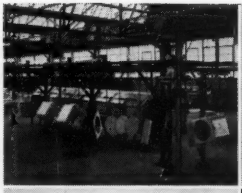

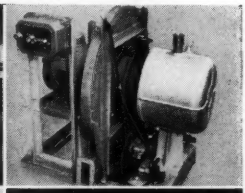

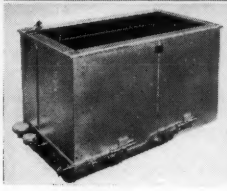

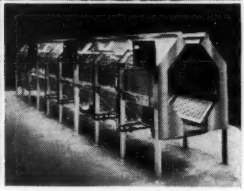

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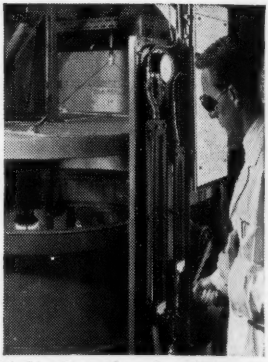

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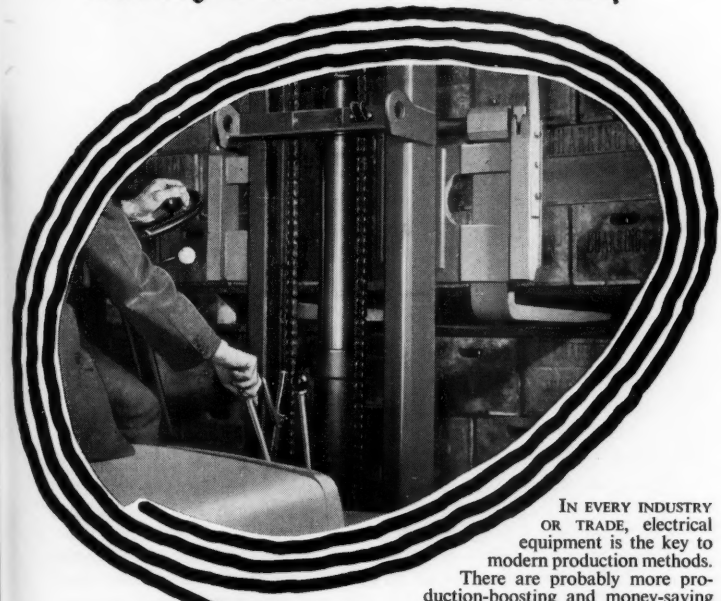

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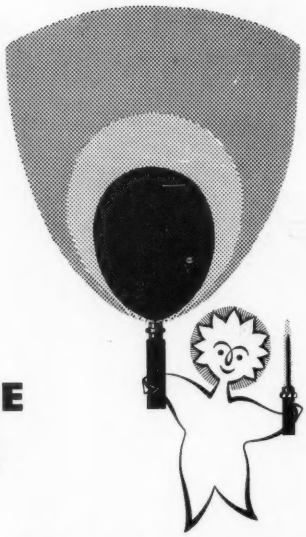

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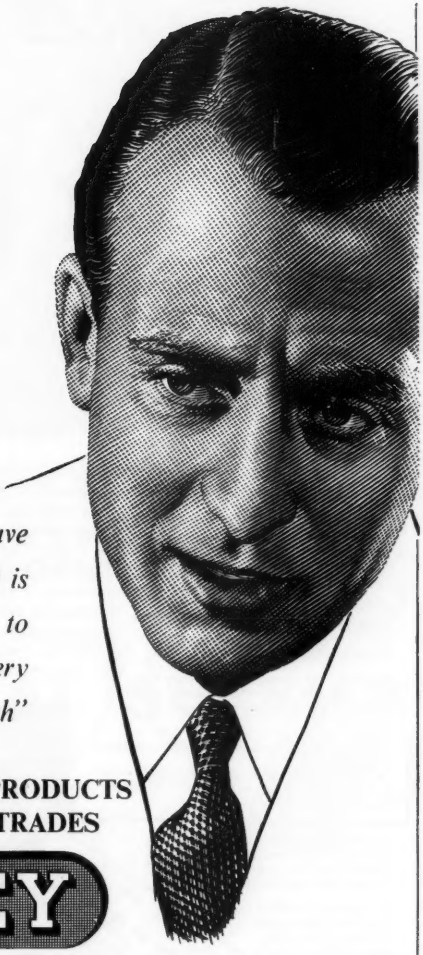

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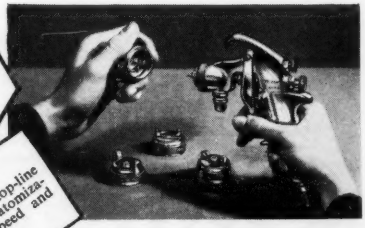

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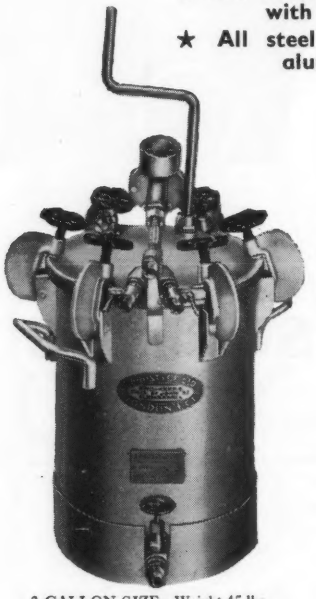

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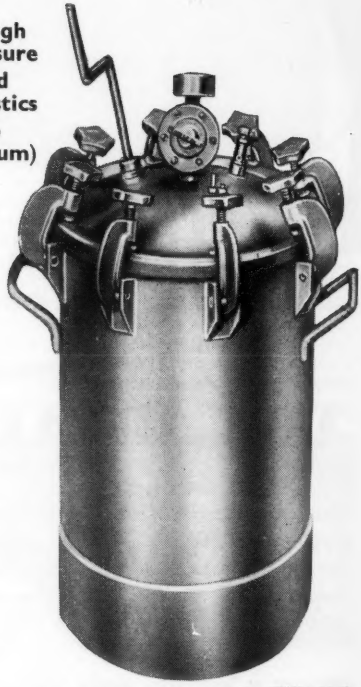

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NOVEMBER 1954

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Industrial Finishing

VOL. 7 NOVEMBER, 1954 NO. 77

The Designer and the Finish

VISITORS to the Motor Show must realise from the emphasis upon colour that the job of the finishing shop is becoming more difficult, rather than easier. The trends in colour schemes evident at last year's Show have emphasised themselves, so that many of the medium-priced cars are making great use of the two-tone colour scheme. Instead of colour standardisation the choice available to the customer is increasing—the new Vauxhall "Cresta" offers eleven colour choices and four are two-colour schemes.

Undoubtedly this transition towards brighter colours will affect overseas sales in particular. Recently, we had an opportunity of examining the colours on the Nash Metropolitan manufactured by Fisher and Ludlow, and undoubtedly their Caribbean Blue stood out against last year's British counterparts in colour, although it would appear that leeway has been made up this year in this respect.

However, a wide colour choice throws increasing responsibility not only on the finishing shop but on the suppliers of finishing plant and materials. In the past there has been a continuous complaint from the finishing shop that the designer is rather more concerned with the appeal of his shapely lines on paper than he is in interpreting these lines in terms of the press shop and the multitudinous number of manufacturing operations to be performed before the gleaming finish materialises. And after all, the whole of the ingenuity of a motor-car development organisation is presented to the outside world through the medium of its finish. The latest world beauty queen with all her natural attributes, would have got short shift with a dishevelled head, inferior make-up and a dingy skin covering.

In short, finish in the motor-car industry is the No. 1 selling point—the greater the variety, the greater its potential break into the competitive overseas market. But the development and design engineers must, of course, realise that their genius will be lost to posterity if their draughtsman's dream in outline cannot be clad in pleasing clothes. Even still, the finishing shop is often the last part of the organisation to be called in to a development discussion. This is bad business and can react very unfavourably on ultimate sales.

Applications of Chlorinated Rubber Paints

SPECIALLY CONTRIBUTED

RUBBER paints have been known and widely used for a number of years. Their chief advantage usually lies in enhanced resistance to chemical attack. The simplest types have been straight rubber solutions or cements (raw rubber dissolved in suitable organic solvents); or rubber varnishes, where raw rubber is employed as an additive in an otherwise normal type of oil varnish. The former types suffer from the disadvantage that deposited coatings are generally thin, necessitating at least two coatings for adequate protection. Adhesion of an unvulcanised rubber solution or rubber cement may also leave much to be desired. In the case of rubber varnishes the proportion of rubber which can be incorporated is small, otherwise the viscosity of the varnish is increased beyond suitable limits.

Much more satisfactory results have been achieved with pre-treated rubber. By first partially oxidising the raw rubber by milling with a suitable catalyst (e.g., a normal paint dryer), solvent properties of the rubber are greatly improved whilst much of the "rubbery" properties are retained. Oxidised rubber in a 50:50 solution with a spirit solvent may then be used to replace the drying oils in normal decorative paints.

Better results still, however, are obtained by the use of chlorinated rubber which has the desirable feature that high proportions can be incorporated in a fairly wide range of normal solvents without resulting in an excessive increase in viscosity. Chlorinated rubber has excellent film forming properties coupled with a general inert behaviour—resistant to acids, alkalis, corrosive gases, etc., impermeable to water and water vapour, non-toxic and non-flammable. Although their fundamental preparation may be the same, chlorinated rubber paints are about ten times as resistant as normal paints to the passage of water vapour; incomparably superior to linseed oil and similar paints in resistance to acids, alkalis and chemical attack; and tend also to show greater durability under arduous service conditions. The main disadvantage is that chlorinated rubber has certain temperature limitations and tends to show marked decomposition at temperatures much in excess of 125° C.

The manufacture of chlorinated rubber is a fairly straightforward process. Raw rubber is first dissolved in a solvent inert to chlorine (usually carbon tetrachloride), after which chlorine gas is passed through the solution. If the chlorination is carried out completely at the boiling point of carbon tetrachloride the resulting product has a fully saturated molecule which is extremely stable and essentially inert, i.e., has no tendency to react chemically.

In appearance, chlorinated rubber is a fine white powder, containing about 65 per cent. chlorine in the combined state. It is soluble in aromatic hydrocarbons, esters, ketones and certain oils. It is not soluble in water, alcohol or aliphatic hydrocarbons, although petroleum hydrocarbons, alcohols, etc., may be used as diluents. As a general rule, where esters or ketones are used as the basic solvent, white spirit, etc., may be employed as a diluent to a considerable proportion before precipitation occurs. Where a chlorinated hydrocarbon solvent is employed in the first place, however, the proportion of non-solvent diluent which can be added is greatly reduced.

Commercially, xylene or toluene are widely used as the basic solvents and also as thinners. Higher boiling point solvents may also be included in the

paint formulation to extend the drying time. Some typical solvent combinations are summarised in Table II. It is general practice for manufacturers to supply (or specify) suitable thinners for their products, which solvents are also used for cleaning brushes and spray equipment.

In simple solution, chlorinated rubber dries to a pale yellow to colourless film which is tough and reasonably elastic. To avoid any suggestion of brittleness, however, it is usual to incorporate a plasticiser. A wide range of natural drying and non-drying oils and synthetic plasticisers are compatible with chlorinated rubber, such as linseed oil, castor oil, tricresyl phosphate, etc. It has been found, however, that certain other properties may be enhanced by the selection of suitable plasticisers. Chlorinated paraffin wax, for example, results in maximum chemical resistance. Alkyl phthalates enhance resistance to ultra-violet light and sunlight. Certain hard resins improve gloss and fire resistance; and so on.

Some medium and long oil alkyd resins are compatible with chlorinated rubber which, included in a chlorinated rubber paint, may improve the hardness of the film. Many brushing finishes are formulated on this basis.

TABLE I. GENERAL PROPERTIES OF CHLORINATED RUBBER.

Characteristics	*Data*		
Typical trade names	Alloprene, Parlon, Detel, Duroprene, Turnesit, Tretol, etc.		
Composition	Approximately $C_{10}H_{17}Cl_7$ (65 per cent. combined Chlorine)		
General properties	Powder, Colourless, Odourless, specific gravity 1·6.		
Typical solvents	Amyl Acetate Benzene Butyl Acetate Carbon Tetrachloride Chloroform Dichlorethylene Furfural Diethyl Carbonate	Isobutyl Acetate Isobutyl Acetate Methyl Acetate Methyl Amyl Ketone Methyl Cyclohexanone Methylene Chloride Methyl Ethyl Ketone	Methyl Salicylate Nitrobenzene Solvent Naphtha Perchlorethylene Toluene Trichlorethylene Xylene
Partial solvents	Acetone Castor Oil	Creosote Ethyl Ether	Linseed Oil Tung Oil
Compatible plasticisers	Amyl Oleate Butyl Stearate Castor Oil Chlorinated Diphenyl Chlorinated Paraffin Wax Dibutyl Phthalate	Diethyl Phthalate Diethyl Phthalate Fish Oil Linseed Oil Nut Oil Papeseed Oil	Soya Bean Oil Tributyl Phosphate Tricresyl Phosphate Triethyl Citrate Triphenyl Phosphate Tung Oil
Resistant to	Most Common Acids (Hydrofluoric Acid—vapour only) Most Common Alkalis (Welding Ammonia Solutions) Strong Oxidising Agents (e.g., Peroxides, etc.). Strong Balancing Agents (e.g., Hypochlorites, etc.). Salt water. Most Gases (e.g., Chlorine, Fluorine, Ammonia, Flue Gases, etc.)		

Alternatively, chlorinated rubber may be incorporated in otherwise orthodox alkyd enamels—both air drying and stoving finishes—for improved gloss and chemical resistance, coupled with a harder, more durable film.

Correct solvent balance is of particular importance in the preparation of all chlorinated rubber paints. The basic constituents are chlorinated rubber, plasticiser, pigment and solvent. Solvent balance is important to control the rate of evaporation and thus the rate of drying on the surface of the film. For brush finishes a total solvent content of between 50 and 60 per cent. is usual, the solvent incorporating some 40 to 50 per cent. of a high boiling point (slow drying) constituent. Spray finishes average about 70 per cent. solvent, or somewhat less in the case of a sprayed-on primer—see Table III.

Most normal paint pigments can be used in the formulation, proportions generally following the figure of 10 per cent., by weight, for finishing paints and twice this figure for primers. The pigment is ground in with the plasticiser, which itself is first dissolved in approximately one-quarter of the required amount of solvent. The remainder of the solvent is then added, followed by the chlorinated rubber. Grinding continues until a perfectly homogeneous mixture results. The further addition of finely divided quartz or carborundum has also been suggested to give additional resistance under arduous service conditions where the coating may be subject to blows or intermittent "hammering."

Some specific applications of chlorinated rubber paints can now be considered in detail. As a coating for metal surfaces, chlorinated rubber finishes give a harder film than oil lacquers together with appreciably enhanced corrosion resistance. Primers are usually pigmented with red lead, lead oxide, zinc chromate or metallic zinc (powder), depending both on the type of metal being treated and the environment. A metallic zinc content in excess of 90 per cent, has been used in certain cases, giving, in effect, a galvanized undercoating.

Treatment of metals with chlorina-

TABLE II. TYPICAL SOLVENT COMBINATIONS.

(After I.C.I. Recommendations for "Alloprene" Formulations).

	per cent. weight of total					
Basic solvent (Xylene)	50	50	50	50	50	45
White Spirit	20	—	—	—	30	—
Diethyl Carbonate	15	10	30	—	—	20
Cyclohexanone	—	15	20	20	20	—
Dipentene	—	25	—	30	—	—
Tetrahydro-Furfuryl Alcohol	15	—	—	—	—	—
Solvent Naphtha	—	—	—	—	—	35
Total	100	100	100	100	100	100

TABLE III. GENERAL PURPOSE (Basic) FORMULAS.

	Brush Application		*Spray Application*	
Constituent	*Primer*	*Finish*	*Primer*	*Finish*
Chlorinated Rubber	15-17·5	16-20	15	10-15
Plasticiser	10-11·5	13-15	10	10
Pigment	20	10	13-15	10
Solvent (Total)	50-60	60	60	65-70
	100	100	100	100

ted rubber paints has proved particularly effective in corrosive ambient conditions. For example, it affords excellent protection to structural steelwork under circumstances where acid or alkali fumes may continually be present and unavoidable; also for plant and equipment operating under "corrosive" conditions, such as in paper mills, sewage plants, air-conditioning equipment, etc. There have been numerous recorded examples of material savings in this respect, treating ordinary steel plant with chlorinated rubber paint and thus avoiding the extra cost of corrosion-resistant materials, such as stainless steels, ceramic linings, etc.

Another wide field of application of chlorinated rubber paints is in the coating of alkali containing surfaces, such as concrete, cement and brickwork. Such surfaces need no special priming or sealing treatment and rubber paints can be applied direct, provided the surface is initially dry. A preliminary wash with 5 to 10 per cent. nuratic acid is sometimes used. The first undercoat is usually heavily pigmented to close the pores in the surface being treated and provide a surface barrier. Unlike oil paints, there is no danger of the free alkali in cement, asbestos or new plaster causing saponification and the finish is tenacious, durable and strongly resistant to weathering. Chlorinated rubber exterior finishes generally show up to particular advantage in salt air atmospheres where a "life" of four times that of an orthodox exterior oil paint should be attainable.

Chlorinated rubber paints are not, however, particularly suitable for finishing exterior woodwork since their impermeability to water vapour would trap unwanted moisture inside the timber. It is suggested, however, as an excellent protective medium for timber exposed to chemical attack. Similar limitations may be experienced with other types of surfaces, but in general a wide variety of building materials may be protected and/or decorated with chlorinated rubber paints or normal oil paints fortified with chlorinated rubber.

The basic chlorinated rubber paints previously described (e.g., Table II) are essentially the general purpose acid- and alkali-resistant types, suitable for application over most metallic surfaces. Maximum protection demands the use of a suitably formulated primer which in itself forms, in effect, a separate protective coating. Formulation may vary slightly according to whether or not the paint is required to give a decorative as well as corrosion-resistant coating and the finish itself may vary from matt to full gloss.

Titanium dioxide is particularly suitable as a pigment for chlorinated rubber paints and is normally incorporated in all water-resistant paints of the type used for coating swimming baths and in deck paints for marine use. Such finishes are generally white, although coloured compositions are available, retaining titanium dioxide as the basic pigment. The protective film is hard and durable and, being of an inert nature, remains comparatively

free from algæ formations. As such it is ideal for many other underwater applications although in the case of ships' hulls an anti-fouling formulation is to be preferred.

The basis of an anti-fouling finish is simply that the coating incorporates a water soluble "poison" suspended in it which slowly leaches out and, by rendering the adjacent area poisonous to marine life, inhibits fouling or the adhesion of marine growth to the hull. Originally when ships had wooden hulls, sheathing the hull bottom in copper was standard practice. With the introduction of metal hulls, copper sheathing was no longer practical due to electrolytic reaction between steel and copper and so paint finishes incorporating mercury oxide poisons came into use—mercury being a more effective "poison" than copper, in any case. Organic poisons have now replaced mercury oxides to some extent whilst longer-lasting "plastic" anti-fouling compositions have also been introduced. Anti-fouling compositions based on chlorinated rubber paints retaining red cuprous oxide as the "poison" constituent are claimed to give satisfactory results. Alternatively the use of a chlorinated rubber paint as an undercoating for a normal anti-fouling finish can lead to excellent results. Much research remains to be done on this subject, but undoubtedly chlorinated rubber paints show considerable promise for marine finishes.

Chlorinated rubber paints have also exhibited excellent mould resistance

TABLE IV. CHLORINATED RUBBER PAINTS CLASSIFIED BY APPLICATIONS.

Main property required.	*Special feature(s)*	*Typical Applications*
Corrosion resistance	Protection against: Poluted atmospheres, corrosive atmospheres, damp atmospheres, weathering, etc.	(1) Protection of structural steelwork (exterior) (2) Protection of plant and equipment (interior) (3) Decorative exterior coatings for plant, buildings, etc.
Chemical resistance	Coatings resistant to acids, alkalis, bleaching agents, etc.	Protection of plant and equipment in dairies, breweries, plating shops, paper works, soap mills, etc.
Water resistance	Coating impermeable to water free from algæ growth.	Painting concrete swimming pools, marine deck paints, top-side finishes, anti-fouling compositions.
Alkali resistance	May be applied to alkali-containing surfaces without danger of saponification.	Protective and finish coatings on concrete, plaster, brickwork, etc.
Fire resistance	Flame-retarding coatings.	Incorporated in fire-resistant paints.
Water resistance	Waterproof coating.	Waterproofing paper, textiles, etc.
Mould resistance	Inert, washable coating.	Inhibits mould formation.

since such coatings do not contain any ingredient which would assist mould formation. Hence in situations prone to promote fungus growth, coating with a chlorinated rubber paint and washing down with disinfectant at regular intervals can provide complete freedom from mould formation.

Chlorinated rubber is also a useful base for the preparation of fire-retarding paints, being essentially non-flammable although itself subject to decomposition at elevated temperatures. To counteract any acidity which might be formed by decomposition a small proportion of calcium chloride can be added. Flame resistance is dependent to a certain degree of the chlorine content, increasing with increasing chlorine. Hence fire-retarding paints compounded with chlorinated rubber can with advantage employ a chlorinated paraffin wax plasticiser, also with a high chlorine content. The total solvent content is also usually reduced slightly.

The so-called traffic paints (which are also excellent for floor paints, since they provide resistance to grease, oils, water, etc., as well as being remarkably durable), usually incorporate a small proportion of alkyd resins. A useful feature is their quick-drying properties—generally touch-dry within about 15 min. of application, although this may be lengthened somewhat if a slow-evaporating solvent is incorporated to eliminate brush marks on

TABLE V. OTHER TYPES OF RUBBER PAINTS.

Type	*Special properties*	*Applications*	*Remarks*
Rubber varnish	Improved protection.	Limited: Preparation of rubber varnishes.	Max. rubber content low if viscosity to remain low.
Rubber cements	Waterproof coatings.	Very limited.	Thin film, not particularly stable.
Oxidised rubber	Inhibits "settling" and striation.	Preparation of flat paints and undercoats for use on interior surfaces.	Applicable by brush. roller or spray.
Rubbone	Good resistance to heat, acids, alkalis, etc.	Used in the manufacture of stoving finishes.	A form of oxidised rubber.
Cyclised rubber	Good anti-corrosive and chemical resistant properties.	Heat-resistant paints chemical-resistant undercoats and finishes, floor enamels, waterproof interior paints.	Partially unsaturated rubber. Oxidises on exposure.
Sulphonated rubber	Outstanding adhesive properties.	Coating glassware. etc.	Chemically inert.
Latex	Good adhesion.	Dip coatings.	Waterproof coatings.
Stabilised latex	Good chemical resistance.	Floor coatings, tank coatings.	Plastic composition.

drying. Whilst traffic paints are restricted to white (or yellow), floor paints are produced in a variety of rich colours. Both formulations are essentially similar.

Chlorinated rubber can also be emulsified by the employment of suitable emulsifying agents and in such form has found limited application in the formulation of emulsion paints. Few of the normal advantages of chlorinated rubber are retained, however, the resulting film tending to be porous. In slightly different fields, "straight" solutions of chlorinated rubber have been used for waterproofing and flameproofing paper, paperboard and textiles; in printing inks; adhesives; and bottle-capping compositions. A particular application of the latter is in the sealing of bottles containing corrosive fluids.

To round off the picture, some of the leading properties of other types of rubber paints might also be mentioned. Oxidised rubber paints (raw rubber oxidised to reduce its viscosity) are used in rubber solution form in flat paints and undercoats for brush application. The presence of rubber reduces striation (reducing rubbing down time between coats), gives rapid drying and good cover. Oxidised rubber incorporated in stoving finishes increases resistance to corrosion and water, etc. Isomerised or cyclised rubber is incorporated in primers for concrete, plaster, etc., chemical-resistant undercoats, finish coatings in heat-resistant paints and interior decorative finishes (particularly those subject to a steamy atmosphere or extreme condensation). Some further data are summarised in the tables.

BATTELLE'S 25th ANNIVERSARY

ON the 1st of October this year, Battelle Institute, Columbus (Ohio) completed its 25th year of service. Founded to conduct research on a non-profit basis, Battelle began operations in 1929. In its twenty-five years of existence, Battelle staff members have published more than 2,000 articles, books and papers reporting the results of their research.

The institute provides the physical plant, equipment, and personnel for conducting research. Industrial concerns, groups of companies or individuals contract with the institute for its research services. They are known as "sponsors." All results from research, which are completely confidential, become the exclusive property of the sponsor for which he is billed at the cost price, plus a proportionate share of undistributed expenses. The amount of money thus annually invested in sponsored research projects at Battelle increased from $80,000 in 1933, to $15 million by 1954, through the combined research institutes at Columbus, Frankfort and Geneva. The 25th anniversary has a significance important to Battelle as during this year the European laboratories at Frankfort and Geneva have come into full operation for the benefit of European industries. Complementing these laboratories there are offices in London, Paris, Milan and Madrid. On the 1st August Battelle opened its European office in Geneva, Switzerland, to co-ordinate its activities in Europe, under the management of Dr. F. C. Croxton. He joined Battelle, Columbus, in 1939, and was during four years head of the chemical research department. He has written many articles in the fields of organic and physical chemistry as well as chemical economics.

Two thirds of the Battelle staff members are scientifically trained research men and technicians, and the institute conducts research in practically all fields of technology, including electro-chemistry, paints and plastics.

British Welding Research Association.—The Metallurgical Laboratories of the British Welding Research Association are holding "Open Days" on the 23rd and 24th November, 1954, at 29 Park Crescent, London, W.1. Researches on both ferrous and non-ferrous alloys will be displayed covering many welding processes including the argon-arc, metal arc and self-adjusting arc processes.

"Finishing Aluminium Castings."—We are sorry that in the article "Finishing Aluminium Castings" in our September issue no reference was made to the fact that the paper of Mr. A. P. Fenn, "Developments in Finishing Aluminium Castings," on which the article was based, was originally prepared for the Aluminium Development Association and first presented at a Symposium on Aluminium Alloy Castings in 1952.

Protection by Phosphatising

—Specially Contributed

THERE is little need in an article of this kind to emphasise the importance and need for protection of metallic surfaces against corrosion—the question today merely resolves itself into one of choosing the most suitable method according to the nature of the product, its end use, and the circumstances under which it is manufactured.

Protective coats are the most widely recognised form of preventing corrosion, and now that the value of such processes as phosphatising and chromatising have been acknowledged, added emphasis has been given to this method.

Phosphating, or phosphatising, does not in itself prevent corrosion. It is applied to zinc base die castings, to hot dip galvanised coatings, to steel, zinc, tin and cadmium plates, in such a way as to prepare the metal for a sealing material such as oil, lacquer or paint. In the case of hard barrier coatings such as lacquers and paints there is an infinitely improved contact between the metal surface and the protective film, so that corrosion is prevented should the article become damaged.

The original process was patented by Coslett in 1906 and was applied solely to the ferrous metals. Coslett originally used phosphoric acid and later a solution of ferrous phosphate containing free phosphoric acid. The bath was used as hot as possible and the article to be treated was processed for about 30 minutes. The phosphate film produced was of a grey colour and rather dusty.

Coslett afterwards used a solution of zinc phosphates in phosphoric acid associated with iron phosphate. Trouble was experienced with the loss of efficiency by the progressive increase in the concentration of soluble iron salts in the bath, and this was overcome by the use of small proportions of mild oxidising agents. These oxidise the excess soluble phosphates to the insoluble ferric phosphates which are precipitated and the life of the solution is extended. In this way Coslett's original solutions have progressed to the form in which they are used today.

There are two types of process in general use—the unaccelerated bath and the accelerated bath. As already mentioned, accelerators are mild oxidising agents which improve the efficiency of the processing baths and shorten the processing times. In this way treatment times around 30 minutes are achieved with such oxidising agents as inorganic nitrates, nitrites, and chlorates. Other compounds such as copper salts, bisulphites, aniline, nitrobenzene, and formic acid have also been used. It is thought that the accelerators act by increasing the ratio of the cathodic to the anodic areas on the metal surface, with deposition of the insoluble phosphates on the cathodes and solution of iron at the anodes.

The composition of the coating depends upon the formulation of the treatment bath and may be straight iron phosphate, zinc phosphate, or iron/zinc phosphate or manganese/iron phosphate. The choice of coating depends upon the nature of the component to be treated, type of work and the conditions under which the article is to be used—such as whether it is required to assist lubrication of friction surfaces or whether it is to be painted. Coatings which are to be sealed with an oil film will differ from that employed for light gauge steel pressings which are to be subsequently finished with lacquer and must possess a high degree of finish. Manufacturing operations, space available for machinery, and time available must

all be considered in the choice of process.

Solution of the metal in phosphoric acid results in the formation of a series of salts of the metal. The primary salts are soluble in water, but rapidly hydrolise with the precipitation of virtually insoluble secondary salts and the insoluble tertiary salts. If the ratio of free acid to the combined phosphoric acid is suitable, precipitation of the secondary and tertiary phosphates takes place at the metal/solution interface, a crystalline layer forming on the metal surface. The corrosion resistance of the coating depends upon its tertiary phosphate content.

The use of an extremely dilute rinse of chromic acid, or mixed chromic and phosphoric acids, before the drying off stage, has a pronounced beneficial effect upon the corrosion resistance of the phosphate coating. It has been suggested that immediate drying-off from the phosphating bath without subsequent rinsing provides a satisfactory finish, but not only is there little evidence to support this view, many authorities definitely advise against it and strongly urge that the processing solution be thoroughly removed, particularly if it is the accelerated type, before sealing with paint, lacquer or oil.

Processing

Most phosphating processes can be grouped under three headings: cleaning, phosphating, finishing. Cleaning may be by solvents or with an alkali or emulsion. Such solvents as trichlorethylene or white spirit may be used, while the alkalis are generally mixtures of sodium silicate and caustic soda; emulsions consist of emulsified white spirit in water, to which, to achieve maximum efficiency, a small proportion of alkali is added.

Chemical cleanliness is essential before phosphating. Contamination of the surface produces lack of uniformity and, in severe cases, may prevent formation of the coating. Choice of the cleaning method will be controlled by shape and size of the individual work pieces, the material from which they are made and the flow of material to be handled.

Where millscale is present on the metal surface, this is removed by acid pickling or gritblasting, and grease or oil is usually removed by solvent liquid or vapour degreasing or by hot alkaline solutions applied by immersion or spraying. It has been recognised that such surface pretreatments prior to phosphating influence the crystal size of the coatings and that this effect is more pronounced with unaccelerated than accelerated phosphating solutions.

Acid pickling results in the formation of a more coarsely crystalline coating than any of the other cleaning methods, but this is not so important as when a coating of lacquer is to be subsequently applied, as most components which are picked before phosphatising are subsequently finished by oiling.

In order to obtain the maximum corrosion protective value and eliminate any tendencies for loss of gloss of applied organic finishes, smooth, uniform, finely crystalline phosphate coatings are required. Hot spray alkali cleaning followed by hot spray phosphatising will usually produce smoother, more finely crystalline coatings than hot immersion alkali cleaning followed by immersion phosphatising. The cleaning procedure which invariably produces the best phosphate coatings, however, consists of rubbing the metal surface with a rag soaked in white spirits or turps substitute, and following this with a wipe with a dry cloth. This method, however, is obviously not suited to production methods, and development work has been directed towards the formation of similar phosphate coatings without the use of a wiping operation, and cleaners have been evolved for spray application, which induces the formation of a smoother, more glossy phosphate coating. Such cleaners consist essentially of emulsions of solvents such as paraffin in dilute aqueous alkaline solutions and are especially suited for use with spray phosphating plants.

Generally, solvent cleaning is used in small plants, alkali cleaning in large plants (immersion or spray), and emulsion cleaning in specialised plants (application by high pressure sprays). Alkali cleaners are used hot and will remove relatively heavy films of contaminants. Emulsion cleaners are applied at high temperature and high

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pressure. Wiping with a solvent is usually necessary with solvent cleaning to remove gross contamination.

The cleaning method has a very pronounced influence on the weight and crystalline form of the coating. Alkali cleaners result in much heavier and coarser coatings than the other two methods, but the weight of the coating is of a different order with different processing solutions. Precleaning in an alkaline cleaner normally causes the formation of a coarsely crystalline coating, whereas solvent treatment produces a more compact coating of finer crystal size.

A typical schedule consists of seven stages: alkali or emulsion cleaning, two water rinses, phosphating, water rinse, acid rinse, drying. With solvent cleaning the first three stages are eliminated. Care must be exercised to avoid the carrying over of the processing solution from one stage to the next.

Attention must also be given to the surface condition of the material prior to its entry into the cleaning bath, otherwise this may have its efficiency rapidly impaired as the result of gross contamination. With emulsion cleaners, this attention is imperative as the cleaners will not remove deposits of fatty oils such as the general type of corrosion protectives and press compounds. If the cleaning solution is carried over into the phosphating bath, the latter's effectiveness will be impaired due to neutralisation of the phosphoric acid where an alkali cleaner is used, or the formation of scum if an emulsion cleaner is used. In continuous plants, it is usual to employ two rinses, first cold and second hot, to pre-heat the metal and thus speed up the phosphating operation.

Control of the phosphating bath is achieved by titrating a given quantity of the solution with caustic soda. Quantities and strengths are usually stipulated by the chemical suppliers.

From the phosphating bath the work progresses through a rinse or rinses for the processing salts to be eliminated, prior to impregnating or sealing. For this purpose a cold rinse is employed, followed by a rinse of dilute chromic acid or mixed chromic and phosphoric acids.

In these latter rinses, tap water should not be used (unless the chemical supplier states it may be used) as it may cause blistering of the paint coat under high humidity conditions because tap water contains soluble salts. This does not occur with pure water. If a small quantity of chromic acid is added (0·2 per cent.), blistering is virtually eliminated.

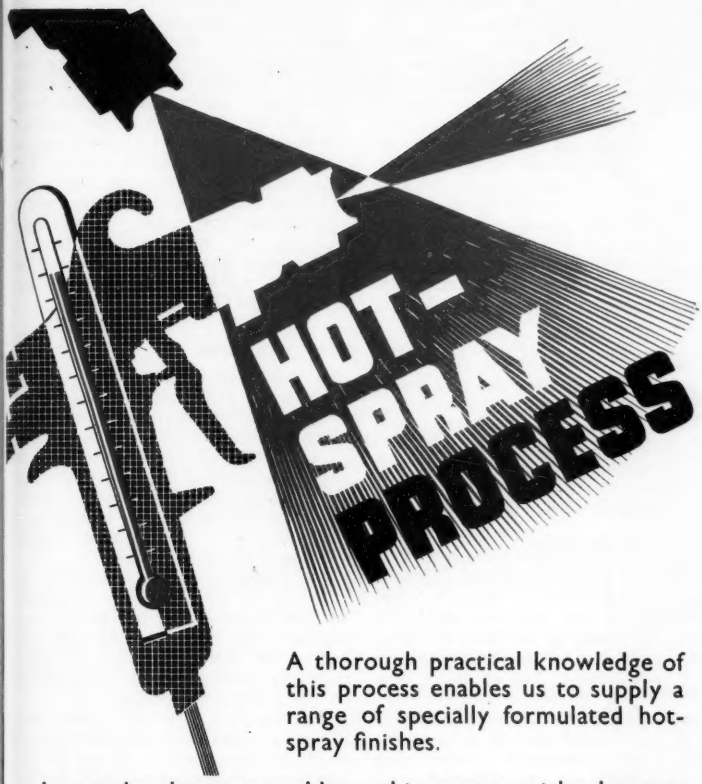
Where work to be processed is already corroded, it is advisable to remedy the condition with a relatively strong acid solution pickle. If the corrosion merely takes the form of discoloration, however, immersion in a proprietary derusting solution (dilute phosphoric acid containing wetting agents) will be effective.

Finishing

The commonest method of impregnation is simply to oil the work with either a mineral oil or one of the oil-type corrosion inhibitors. For some purposes a drying oil may be used. For parts required to have a pleasing appearance without a full paint finish, it is usual to stain the phosphate deposit with a black spirit prior to oiling.

As a pretreatment for painting, the phosphate coating should be relatively light and fine grained in order to provide the necessary key between the metal surface and the paint coating and to prevent corrosion spread should the paint be damaged. In the production of such coatings it is essential that the processing salts are adequately removed; otherwise, in the presence of moisture, osmosis can produce undesirable blistering effects with the possible development of underfilm corrosion.

As a general rule, the quality of the phosphate coating of a given process is assessed on the appearance of the surface of the treated work. The appearance will naturally vary with the type of bath which is being operated and with the nature of the work being processed. Thus, processes for the production of a heavy deposit give a coating quite distinct from that produced by processes intended to give a light, finely crystalline coating intended as a basis for painting. For successful processing the appearance of the coating should obviously be uniform and free from surface dust. Non-uniformity as a rule denotes



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It may be that you could use this process with advantage and if you would like to know more about its possibilities, we will gladly send a senior member of our Technical Staff for consultation and arrange a demonstration at our works.

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inefficient cleaning or incorrect maintenance of the processing bath. Adhesion of the phosphate coating is determined on a workshop scale by scraping with a knife or coin, or by rubbing with fine steel wool. On this point, B.S. PD539 says: "Scrape with a blunt knife and the coating should show a whitish streak; scrape a small area lightly and the coating yields a powder. If the surface is rubbed with grade 000 steel wool the rubbed area should have a dull, polished appearance. A bright burnished appearance indicates that the wool has penetrated the underlying metal and the coating is unsatisfactory."

More recently a B.S.I. panel has suggested the following analytic tests:

Weight of coating per unit area.
Phosphate content of coating.
Moisture content of coating.
Hygroscopicity of the coating.
Absorption value of the coating.

Further performance tests are contained in B.S. 1391/1952.

Zinc Surfaces

Most of the conventional types of phosphating solutions used for the treatment of iron and steel will form phosphate coatings on zinc surfaces. Solutions based on zinc phosphate are most satisfactory, but as there is a tendency for coarsely crystalline coatings to be produced, special solutions have been developed to deal solely with zinc production. One such solution based on zinc phosphate and containing nitrate and nickel as accelerators can be applied either by immersion or spraying and is widely used for the treatment of hot dip galvanised and electrodeposited zinc surfaces and zinc base die castings.

The value of a phosphate coating in producing increased adhesion of organic finishes as well as preventing the spread of corrosion at damaged areas in the film is particularly marked with zinc base die castings, and the finishing problems connected with the manufacture of many die cast toys have been overcome by the introduction of a phosphate treatment. As these are usually given a single coat of enamel or lacquer, a uniform, finely crystalline phosphate coating is essential.

In all phosphating processes the treatment tank must be scrupulously clean and free from deposits of other chemicals. Strength of the solution used usually diminishes with the formation of the coating on the surface of the metal, and the bath thereby needs periodical replenishing. Articles are immersed in the solution for the time specified by the chemical supplier or until gassing ceases. The processing time depends upon the chemical composition and the surface undergoing treatment. Degreased material may take twice as long as shot-blasted surfaces, but generally the treatment is completed when the gas ceases to be evolved.

Plant Equipment

It would be impossible to describe a particular phosphating plant, as the nature of the machinery used, the chemicals employed, time and temperature conditions depend upon so many variables. The only division that can be made is that the goods have to be chemically treated and they have to be handled either mechanically or by hand.

The actual process is usually decided by the supplier of the chemicals, and the decision that has to be made concerns the number, order and timing of the operations and the compositions, strengths and temperatures of the processing solutions.

The simplest form of a plant consists of a series of tanks, one for each stage of the process, in which the goods are successively dipped for the required time either singly or in batches. This is the most suitable form for relatively small outputs. The goods are transferred from tank to tank by a simple lifting block or by a powered hoist running along the row of tanks on an overhead runway. Most of the tanks are heated and in giving off steam the goods are sometimes carried on a jig beneath a transportable tank lid.

Large numbers of small objects such as bolts and nuts may be processed in tanks by placing them in baskets or perforated drums which are immersed in the solutions and which may be mechanically rotated. This is common practice where the heavier types of phosphate coating produced in iron-manganese phosphate solutions are applied.

For any considerable output of

Outstanding past achievements—an export record second to none—a future brilliant with prospects of even greater technical advances and prosperity—the British Motor Industry has earned the right to be proud.

And in the manufacture of Britain's fine cars Pyrene Metal Finishing Processes are widely employed with the objects of providing a firm foundation for a first-class finish and maintaining it up to scratch, resisting rust and corrosion and reducing wear on vital moving parts.

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Bonds paint to Metal Surfaces.

BONDERIZING
Assists the Cold Forming of Steel

PARKERIZING
Rustproofing Process

PARCO-LUBRITE
Reduces wear on Moving (Ferrous) Parts

PYLUMIN
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THE PYRENE COMPANY LIMITED—METAL FINISHING DIVISION

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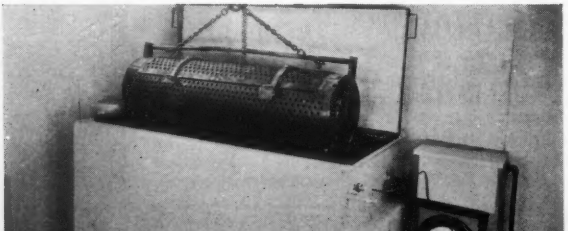
larger goods continuous or conveyorised plants are usual. These may process the goods by simple immersion, the conveyor being used to lower the goods into each tank in turn for the necessary time. When goods of large size, such as sheet metal panels or pressings, are phosphated, it is usually as a preparation for painting. For this purpose lighter and smoother coatings are required, and these need shorter immersion times in the solution. The conveyorised immersion plant has, however, become less usual since the introduction of the spray-phosphating process, but it is still required in special cases.

In the spray-phosphating process the goods are treated by spraying them with various solutions instead of immersing them. By spraying, a satisfactory phosphated surface for the application of paint is produced in a fraction of the time required by immersion. This not only cuts down the length of the plant but greatly simplifies the arrangement of the conveyor, which does not have to raise and lower the goods. For the phosphating of sheet metal articles in quantity, this type of plant is now very largely used. Components from small pressings to complete motor-car bodies are dealt with in this way, and the method is used in the manufacture of cycle frames, refrigerators, office furniture, domestic appliances, etc.

A development of this method is one in which such articles as complete motor-car bodies pass through the plant and are sprayed, dipped and sprayed again while being rotated. Thus all surfaces of the body outside and inside can be phosphated and painted.

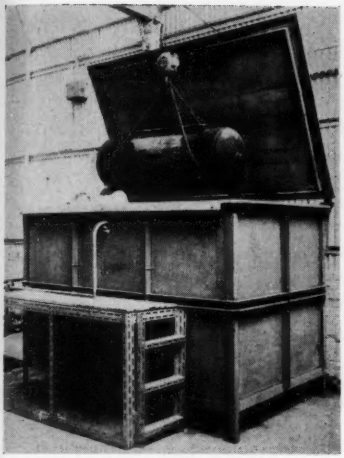
In some cases the choice of plant is a problem. In phosphating sheet metal panels or pressings as a preparation for painting, for example, phosphating solutions can be formulated either for immersion or spraying. If the output of goods is sufficient to justify a continuous conveyorised plant then the spray method is chosen, since spray phosphating takes less time than dip phosphating and, in a conveyorised plant, to cut down time is to cut down conveyor and plant length. But in the spray process, the goods must be disposed in their passage through the plant in such a way that all surfaces to be treated are directly accessible to the spray. Except in obvious cases where articles may go through the plant several abreast, this means that the goods must be processed in single line.

For all usual applications each successive stage will require a tank, either to dip the goods in, or, in the case of a spray plant, to hold the solution being sprayed. Tanks are usually made in heavy mild steel plate, of welded construction, and the phosphating tank is often, though not always, rubber lined or made of stainless steel. Smallish tanks which can be easily replaced can be of mild steel



Phosphating tank and barrel

(Photo by courtesy Walterisation Ltd.)



Spray plant installed at Bristol Pneumatic Tools Ltd.
(Photo by courtesy Jenolite Ltd.)

while tanks which are built into a continuous plant should be made for longer life. Most tanks, depending on the process schedule, will be heated and their design must allow for coils or other heating devices. They must also allow for the accumulation of sludge which is deposited in most tanks, particularly the phosphating tank. The goods must not touch or disturb this sludge.

In all tanks the heating arrangements should not be placed near the bottom of the tank as this would disturb the sludge and result in bad deposits. For the same reasons the solutions are never heated above 100° C. or 212° F.

The commonest method of heating is by steam or high pressure hot water inside pipe coils. Mild steel coils which are periodically de-scaled are generally used.

In spray type plants, spray nozzles are used which break up and atomise the solutions and direct them forcibly on to the goods. A typical spraying pressure is 10-15 lb. per sq. in. The nozzles, spray piping and pump handling the phosphate solutions should be of stainless steel. Conveyors for continuous plant should be protected as far as possible from contact with the processing solutions. It is important that the goods are transferred from one stage of the process to the next without delay. One reason for this is that oxidation between stages must be avoided, while another is that the chemical used in each stage must be removed before proceeding to the next. After cleaning with hot alkali or emulsion, the goods, when withdrawn, will tend to dry owing to the residual heat in the metal. If the film of cleaning solution dries on the goods it will be more difficult to remove it completely in the rinsing. The same applies to withdrawal from the phosphating stage.

MANUFACTURERS

*The following firms are manufacturers of proprietary phosphating processes: Imperial Chemical Industries Ltd., Nobel House, Buckingham Gate, London, S.W.*1; *Jenolite Ltd.*, 43 *Piazza Chambers, Covent Garden, London, W.C.*2; *Metal Treatments (Birmingham) Ltd., Green Street, Birmingham* 12; *Pyrene Co. Ltd., Great West Road, Brentford, Middlesex; B. J. Round & Sons Ltd.*, 9 *and* 10 *Northampton Street, Birmingham* 18; *Sunbeam Anti-Corrosives Ltd., Central Works, Central Avenue, West Moseley, Surrey; Walterisation Co. Ltd., Purley Way, Croydon, Surrey.*

'EPIKOTES' EXHIBITION

AN opportunity to study the wide applications of the new epoxide resins will be provided by an exhibition entitled "Epikote Resins and Their Uses" to be staged by Shell Chemicals Ltd. at the Criterion, in Piccadilly, London, W.1, from 7th to 11th December, 1954.

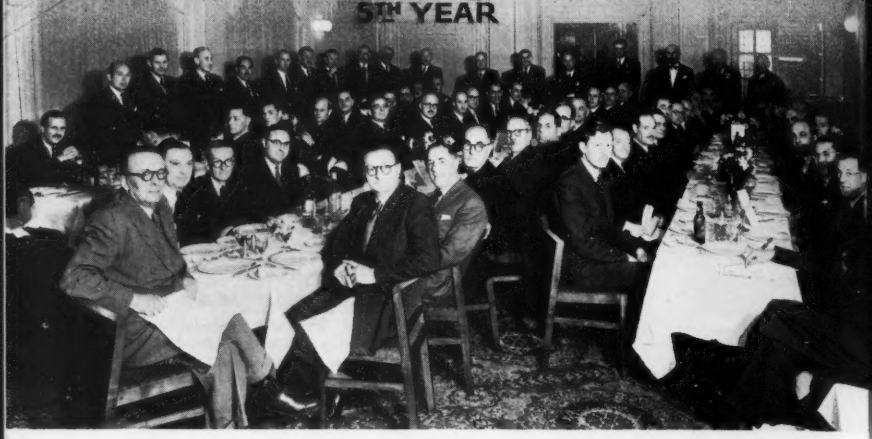
Admission will be by invitation obtainable on application to Shell Chemicals Ltd., Norman House, 105-109 Strand, W.C.2.

The exhibition will be open from 10 a.m. to 8 p.m. on 7th, 9th and 10th December, from 10 a.m. to 4 p.m. on 8th December and from 10 a.m. to 1 p.m. on 11th December.

Powder Metallurgy Symposium, 1954.—A symposium on Powder Metallurgy, organised by the Iron and Steel Institute in association with the Institute of Metals, will take place in the Hoare Memorial Hall, Church House, Westminster, London, S.W.1, on the 1st and 2nd December, 1954. Some fifty papers to be presented cover both ferrous and non-ferrous aspects of powder metallurgy. There will be a small exhibition of powder metallurgy components. The symposium is open to all interested in the subject. Requests for tickets should be submitted to the Secretary, The Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1.

Industrial Finishing Luncheon Club

5TH YEAR



THE fifth session of the Club opened with its meeting on Thursday, 14th October, when Mr. A. A. B. Harvey, M.Sc., A.R.I.C., M.Inst.W., Chief Chemist, Briggs Motor Bodies Ltd., and chairman of the Organic Section of the Institute of Metal Finishing, gave an amusing and stimulating after-luncheon speech dealing with the finishing of motor-cars. It was well up to the customary standard set by many of the past speakers in so far as it was controversial and aroused a good discussion.

It is now, as mentioned above, five years since this informal gathering came into existence. It emerged when the honorary secretary, round about Christmas, 1948, invited a few folks to come along to a small cocktail party. Those who were there thought that some sort of social club would serve a very useful

The photographs on this page show members of the Industrial Finishing Luncheon Club at the meeting on 14th October, held at the Rembrandt Hotel, Knightsbridge. This meeting opened the fifth session of the Club. As one can judge from the number of notable personalities in our photographs, the opportunity the Club provides for people of diverse finishing interests to gather and exchange ideas has been a welcome one.

purpose in enabling people interested in the diverse aspects of finishing to get together. At that time there was no common meeting place for all these different interests such as paint, electroplating, galvanizing, metal treatment and so on.

One of the characteristics of this Club is its complete informality—members join as individuals. The discussions are not reported, and thus there can be an interesting interchange of opinions by various participants including the speaker, without in any way affecting the particular organisation of which he is a member.

The annual subscription is one guinea, and some four years ago it was decided that all the subscriptions should be paid to some charity, and by Christmas this year the Club will have given no less than £250 to Dr. Barnardo's Homes.

The honorary secretary is Dr. W. F. Coxon, 27 Mount Park Road, Ealing, W.5: Telephone Gadebrooke 2308, and its chairman is Mr. W. F. Wilson, Technical Director, Cellon Ltd., Kingston-on-Thames.

There is nothing like giving people who might wish to become members some idea of the kind of folks who come along. Reproduced in this issue are a number of photographs of groups taken at the first meeting of the fifth session. A postcard to the secretary will ensure that you get full details relating to the Club, should anyone be interested.

Ultrasonic Processing of Coatings

by

THOMAS A. DICKINSON

WATER and oil, alcohol and and mercury and many other combinations of immiscible materials are now being incorporated in coating dispersions on a production basis with ultrasonic processing equipment recently developed by McKenna Laboratories at Santa Monica, Calif.

Basic function of the equipment is to generate high-frequency vibrations, or "inaudible sounds," by electrostriction. This involves the conversion of alternating electrical current into radio frequency current for the purpose of expanding and contracting piezoelectric crystals.

Electrostriction has been the most common method of generating ultrasonics for years, but until recently it was limited to relatively small-scale laboratory applications because the only crystals that could be used as electrostrictive transducers were quartz. In addition to being rare and expensive, quartz cannot be satisfactorily machined for all the details that are most desirable in electrostrictive transducers and it has inherent structural defects which limit both crystal dimensions and operational efficiency.

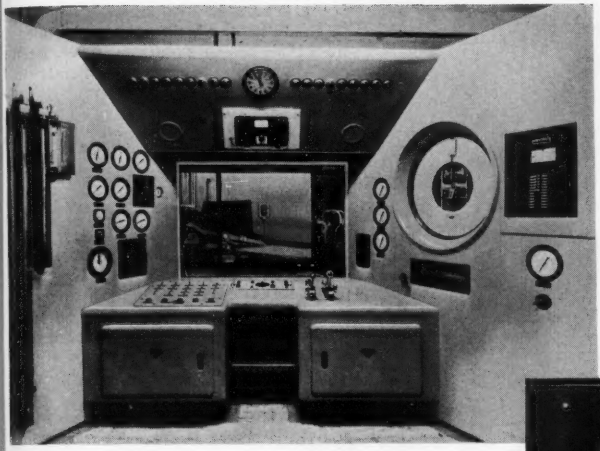
Small ultrasonic units of the type shown here been available for some years, but are generally suitable only for laboratory—not production—work

McKenna has consequently gained a considerable advantage by using "synthesised" ceramic crystals in place of natural quartz crystals as electrostrictive transducers. The synthetic crystals are fabricated by casting and firing barium titanate compositions, much the same as ceramic materials are cast and fired in the manufacture of structural brick and tableware.

Besides having configurations and dimensions that cannot be obtained with natural quartz, barium titanate crystals may have superior electrical properties because they are powerful dielectrics and can be strongly polarised with high-voltage current after they are fired.

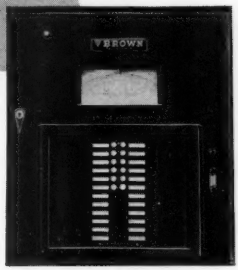
The surfaces of each crystal are metallised so that they will remain polarised (for the same reason that a permanent magnet, equipped with a keeper, will remain magnetised). Then, rigidly retained by a special holder in the base of an appropriate stainless steel processing chamber, the crystal is attached to the output terminals of an electronic device which is virtually the same as a radio transmitter.

Ultrasonic frequencies produced with McKenna's equipment range from about 400 kilocycles to 1 megacycle. They are obtained by using piezoelectric crystals with varying dimen-



General view of the Jet engine test control panel

Test plant supplied by Heenan & Froude Ltd. · Worcester · England



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BROWN INSTRUMENTS

First in Controls

Pictured here is the electronic power supply for one of McKenna's largest ultrasonic processing units

sions, and they serve the primary purpose of concentrating energy at the rate of 100-1,000 watts per square centimetre.

Configurations of the crystals are such that their ultrasonic output is focused with optimum effectiveness on solutions placed in their stainless steel processing tanks. Remarkably little energy is subsequently wasted because ordinary air surrounding the tanks serves as an insulator which keeps high-frequency vibrations from leaving the processing area.

Although it is large compared with older ultrasonic units, most of McKenna's equipment is appreciably smaller than conventional chemical processing equipment because it has a relatively high level of productivity. For example, where it is desirable to produce an emulsion at the rate of 5 gall. per hour, an ultrasonic processing unit with a capacity of only 1 gall. may do the work of a standard mixing device with a 5- or 10-gall. capacity.

Theoretically, ultrasound will not do anything that cannot be done with other forms of energy. But from a practical point of view, this would be hard to demonstrate because ultrasonics can be concentrated in small areas with much greater intensity than the other types of energy that are now being generated by mankind.

The effects of ultrasonics, concentrated within a solution, have been explained by McKenna officials as follows:

"Quite naturally, the liquid is set into a vibration motion at the frequency of the applied sound. The amplitude of this motion depends on the type and quantity of liquid radiated, and the power density and frequency of the sound. For most practical cases, this amplitude is of the order of microns. But at the high frequencies used, even these small amplitudes represent a large amount of energy and tremendous accelerations. For a given amplitude of vibration, the accelerations increase with the square of the frequency. . . .

"As sound amplitude increases, a critical pressure is reached where the liquid is actually fractured and vacuous pockets are formed. The formation and collapse of these cavitation bubbles generate extremely large localised pressures. The total forces are small, but they are so concentrated that a vigorous scrubbing action is obtained.

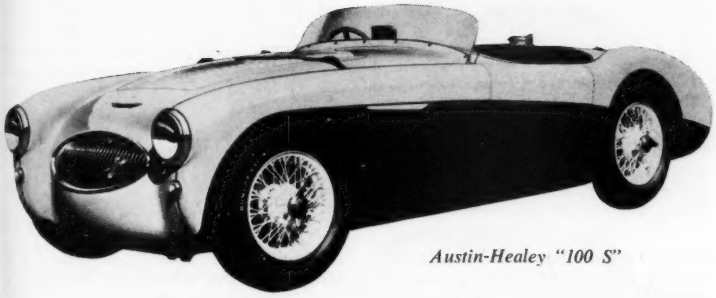
"The presence of cavitation in a liquid can be established by observation of small bubbles and by a hissing sound emanating from the liquid. Because cavitation is a threshold phenomenon, a large volume of liquid can be made to cavitate by using only slightly more power than is required to cavitate a small volume. . . ."

In other words, ultrasonics can disperse immiscible chemicals in a solution because cavitation breaks up the gaseous particles that would cause the materials to remain segregated if they were agitated in a conventional manner. Thus, in addition to permitting the dispersion of standard coating materials in a fractional period of time, McKenna's equipment has made it possible to:

1. Use low-cost fluids such as water in place of the more expensive volatile solvents in the preparation of both organic and inorganic finishing compounds.

2. Mix chemically incompatible resins, plasticisers, pigments, etc., where coatings with unprecedented properties are required.

(Continued on page 274)



Austin-Healey "100 S"

Finishes at the Motor Show

NO one, no matter how often he has been there before, is unaffected by the colour and spectacle of the Motor Show. In part the excitement the visitor feels on entering the exhibition may be due to its sheer size (this year some 280 cars, over sixty caravans, thirty boats and many accessories and components were exhibited) but the *appearance* of the exhibits—their design, the colours of the finishes, the quality and use of plating, the interior trim—undoubtedly has the biggest instantaneous effect on him. Before a visitor enquires about a car's mechanical specifications and performance his eye has formed an impression which, if it does not please him, may well cause him to lose all further interest. This year it was evident from the variety and quality of the finishes that manufacturers were more than ever conscious of the value of this "eye appeal."

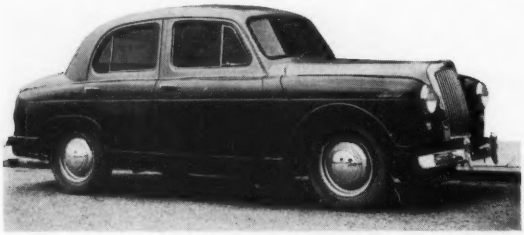
External Car Finishes

Many trends in colour schemes evident at last year's show have grown since then. The obvious success of two-tone colour schemes on medium-priced cars have prompted more manufacturers to use them. They have, too, become an important distinguishing feature for de luxe models of certain makes. When people pay more for any product they like others to see that they have. Wider colour ranges are more prevalent this year.

The new Vauxhall "Cresta," to take one example, is available in eleven colour choices, four of which are two-colour schemes. These colours—such as beach white above Morocco red; kingfisher blue above beach white—are somewhat brighter than those still generally in fashion, but this change may not be unwelcome to many motorists who have tired of the somewhat insipid pastel shades. A two-colour trim of red and ivory goes with the former scheme whilst blue and light green accompanies the latter.

The popular Hillman "Californian" provided another bright and arresting finish. One displayed on the stand this year had a colour scheme of cream with an Oxford blue roof and French grey upholstery. The "hot sun and holiday atmosphere" created by these colours was heightened by overriders, rimfinishers and white wall tyres.

The Austin "Westminster" mounted on a moving stand was another draw to the crowds. This non-standard model was finished in black and white with startling effect. A forthright Lancashire woman behind me expressed the thought of many people,



The Lanchester "Sprite" in two tones of grey

though, when she said "Looks very nice all white inside, but how long is that going to stay white in Burnley?"

Two colour schemes have a noticeable effect on the lines of a car, and it was interesting to compare manufacturers varying approaches to these schemes. Probably the most attractive in middle price range was that used on the French Ford, Vedette. The Regence, the de luxe model is finished with a light tone colour for the roof and upper part of the body. Darker colour is used for the lower half up to the top of the front wheel arches and this shade is echoed on the luggage locker lid and carried forward below the rear window pillars. With the turret top this arrangement of the colour produces a very pleasing elegance of line. The English Ford Zodiac's simpler straight division of the colours just above the wheel arches has an agreeably slimming effect on the car and somewhat dispels the effect of blockiness one gets from the single-coloured saloons in the Ford range. On the other hand Vauxhall's treatment of the roof in one colour and the body in another seemed, at any rate to the writer, to make the car more ungainly.

Other medium-priced cars on which two-colour paint schemes are now being used are the Lanchester "Sprite," Austin-Healey, Hillman Estate Car, Standard "Vanguard" and the Triumph "Renown."

On the coachbuilders stands were the usual fine examples of hand-finished jobs, mostly in cellulose. Amongst the varied colours were two-tone grey with green hide on a Rolls Royce "Silver Dawn," a "Wraith" in black and blue with fawn cloth and hide and burgundy and beige on a sports saloon Bentley.

All the models on the Daimler stand this year were in two-colour paintwork. There was a "Century" in Silver and blue, the new 3½ litre "Regency" in silver above the waist-

The Vauxhall "Cresta." A discreetly chromed radiator grille adds to the effect of this new car

line and maroon below, the 4½ litre "Sportsman" similarly treated, but in silver and black and the seven-seater limousine in blue and black. A hard-top roaster on the Carbodies stand was smartly finished in French grey and red.

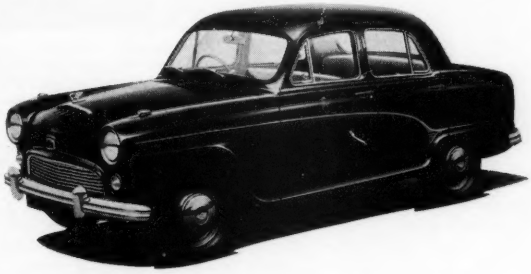
Body Materials

With one or two notable exceptions there is less use of plastics for body-work than might have been expected, although such bodies offer decreased weight and freedom from corrosion. The Singer "Hunter" makes use of resin-impregnated fibreglass for bonnet sides and top, but Kieft and Jensen have produced entirely fibreglass bodies on their models. Clearly Jensen, who produce a small number of high quality cars, have taken a risk, but looking at the sleek lines and attractive appearance of 541 one feels the gamble will come off.

Another means of cutting down weight and corrosion danger has been the employment of aluminium and light alloys in body construction. One of the pioneers in the use of light alloys is the delightful Dyna Panhard, which makes liberal use of aluminium castings and sheeting. Another example is the D-type competition model Jaguar—a monocoque structure built up of magnesium alloy. In the main, other manufacturers used light alloys only for relatively small parts of their cars.

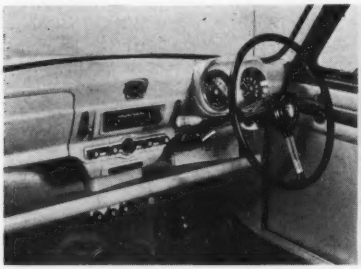
Plating

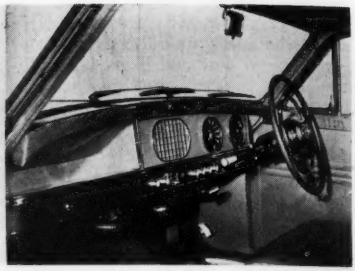
Although plated components are still recognised as essential for the smartness of a car, this year the styling of these components had become more discreet. In general there is less plating on the front of British cars. The Bristol has none except on the bumper bar and lamp surrounds. The Vauxhall "Cresta" has escaped from the unwieldy plating of previous models by using a grille with delicate vertical bars. Chromium strips are still popular as a means of breaking up the effect of the flush sides of the



The Austin "Westminster" illustrates the prevalent use of chromed strips to relieve the monotony of flush sides

The Hillman "Husky," like most Rootes products, is finished mainly in light shades





(Left) *The fascia of the Austin "Westminster," stoved in the same finish as the exterior of the car, typifies the treatment in lower-priced cars. Note the deep parcels shelf.* (Right) *The Wolseley 6/90 features a polished wooden fascia panel. There is a small lockable drawer for valuables on the left*

modern car and to provide a distinguishing feature for new models basically unchanged. The new "Anglia" now has a chromium plated windscreen surround, rear screen surround and windscreen wipers, detail changes which, nevertheless, considerably improve its appearance. Rimfinishers retain their popularity. One striking and elegant wheel finish is the use of plated, louvred ventilating wheel discs on the Sunbeam Alpine sports two-seater.

Trim and Interior Finish

The use of PVC and other plastic-based materials for headlinings and upholstery continues to be widespread. Hardwearing, but above all easily cleaned, it is not surprising that these materials appeal to all those who like to keep their cars new-looking.

A great increase in the variety of coloured upholstery hides was noticeable at this year's show. More than a hundred shades are now available, many of which could be seen in the "Cresta" Wolseley 6/90, "Zodiac," and the Armstrong-Siddeley "Saphire" as well as more expensive cars. Genuine hide can be had as an extra on the Austin 40/50 "Cambridge," and the "Zephyr" and "Consul," the "Velox" and "Wyvern." It is an interesting fact that well over half the cars, including the Morris "Minor," were trimmed in genuine hide.

A practical feature evident in the interior of such cars as the Humber "Hawk" and "Snipe" and the "Cresta" was the fixture of a strip of floor carpet to the lower part of the doors to prevent the door upholstery being damaged or dirtied by passengers' shoes.

Accessories and Components Section

Amongst new products shown by finishing firms at the show were a nitrocellulose-based car finish by I.C.I. Ltd. (Paints Division); a range of basic primers for flow coat application by Robert Ingham Clark & Co.; a cellulose-based gloss enamel by General and Industrial Paints Ltd.; and 4-hour

(Below) *The two-colour twin style of the Vauxhall "Cresta." Upholstery is in leather. Eleven different colour schemes are available. Note how the lower part of the door is protected from passengers' feet*

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M A N D E R ' S

Flamboyant Enamels

MANDER BROTHERS LTD., WOLVERHAMPTON

On the stand of Robert Ingham Clark & Co. a new range of basic primers for flow-coat application was displayed

and 12-hour synthetic coach enamels by Titanine Ltd.

On other stands Aerograph Co. exhibited spray equipment; Docker Bros. had panels finishes with their products; at the Jenolite stand visitors were invited to try the firm's products for themselves on the spot; Pinchin, Johnson & Co. displayed samples of their finishes on panels, doors, wings, wheel rims and other parts; The Pyrene Co. had a working model of a "Spra-Bonderizing" machine and Thornley & Knight showed samples of their vehicle finishes on panels.

(Continued from page 268)

Even such things as silicone resins and copper powder have been satisfactorily emulsified in water by means of ultrasound.

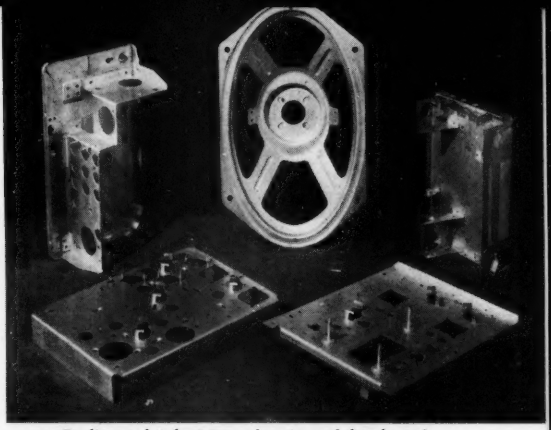
The ultrasonic emulsification unit shown here occupies less than 5 sq. ft. of space, but can do the work of one of the largest mixers now being used in the preparation of organic coatings

Apart from mixing applications, McKenna's equipment has been successfully used to agitate solvent and detergent solutions in the process of cleaning metallic and non-metallic parts. Such agitation was especially practical in work with parts that had small holes and other inaccessible areas, because it greatly increased the wetting action of the cleaning fluids.

The new equipment also has a number of potential applications which are at present nothing more than laboratory curiosities. For example, research has shown that ultrasound can greatly improve the quality of coatings deposited by electrolytic means—its effect being to increase the fineness and dispersion of metallic particles on a deposition surface.

Ultrasonic equipment of the type used by McKenna may find many future applications in small shops as well as in large factories, because it is not inherently expensive. In fact, some of the smaller units shown in accompanying illustrations could be mass produced for little more than the price of a good radio set.

TIN-ZINC ALLOY PLATING*



Radio and television chassis and loudspeaker cases protected with tin-zinc. Electrical and Musical Industries Ltd. are using this process

THE Tin Research Institute recently held a demonstration of the tin-zinc alloy plating process. This process, which was developed during the war, has now reached the stage where the Institute feel able to recommend it. A Ministry of Supply Aircraft Finishes Specification covering tin-zinc is to be issued in January, 1955.

Because of the porosity of tin and the rate of sacrificial attack of zinc coatings neither of these provides separately an ideal protection for steel against corrosion. A composite coating containing both metals averts these disadvantages.

The greatest protection is afforded with a zinc content of around 25 per cent. A good working latitude is to have the upper and lower limits for zinc 30 per cent. and 20 per cent. respectively.

Tin-zinc is most widely employed as an alternative to cadmium. In some cases it has replaced zinc, more especially where good solderability is an advantage. More recently, tin-zinc has proved useful as an alternative to nickel plated finishes. The shortage of nickel has stimulated the search for alternatives, and it has been found that polished tin-zinc is a very effective substitute, both as regards protective value and appearance.

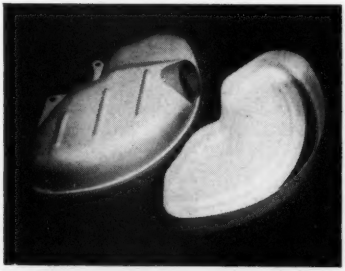
The electrical industry makes extensive use of tin-zinc. Radio chassis, loudspeaker frames, switchgear parts, brackets and numerous small components are being tin-zinc plated in large quantities.

Recent uses include the plating of typewriter parts, carburettor components, and some part of motor-cycles. Small petrol tanks that have to be assembled by soldering are conveniently tin-zinc plated and the double advantage of protection and easy solderability is thus obtained.

As an alternative to nickel, tin-zinc is meeting with considerable success for the finishing of tools such as planes, drills and spanners, and there are many other existing and possible applications.

Full working details are given in the Institute's handbook "Tin-Zinc Alloy Plating" which is free to all enquirers. Free demonstrations are arranged at the Institute.

(Right) *Petrol tanks for motor assisted bicycles are tin-zinc plated before assembly for easy solderability and corrosion resistance.* (Below) *Motor-car "trafficators" are plated before painting*
(Photo by courtesy of The Tin Research Institute)



**A report by Professor J. W. Cuthbertson, formerly Assistant Director of Research at the Tin Research Institute, on the properties and uses of tin-zinc was contained in his article on Electrodeposition of Tin Alloys in* INDUSTRIAL FINISHING, *October.*

RECENT DEVELOPMENTS

MATERIALS : PROCESSES : EQUIPMENT

Airless Spray Painting System

A NEW airless spray painting process was recently demonstrated at the Silvertown works of Pinchin, Johnson Ltd. This system, in which the paint is applied by straight hydraulic pressure, was developed by Bede Products Corporation of America and within two months is to be manufactured in England under licence by T. C. Spray Finishing Systems Ltd. Airless spray is claimed to have a number of impressive advantages over both cold spray and present hot spray processes, chief of which advantages are economy and ease of operation.

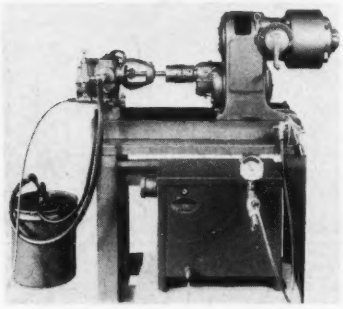
Paint is syphoned by a pump into a standard 4-kW Bede paint heater. Heated, it is carried under controlled pressures to the airless spray gun and the unused portion recirculated. Constant circulation is necessary to ensure a supply of hot paint continually at the gun. The gun is approximately half the weight of the normal compressed air type. Because of the high pressures involved the fluid hoses are "Teflon" lined and can stand pressures of up to 1,000 p.s.i. within a temperature range of 60-450° F. This hose is unaffected by natural or synthetic solvents.

Two factors cause the paint released from the gun to atomise. The first is the mechanical force of liquid released through a restrictive nozzle; the second, vapour pressure. A fraction of the solvent is brought close to boiling point (synthetics are heated to between 180° F. and 200° F.; lacquers to 200° F.). Because the circuit is under pressures varying from 300-600 p.s.i. the solvents do not boil but burst into gas on release into the atmosphere.

The greatest advantage claimed for the airless system is its economy. Mr. Bede maintains 90 per cent. of the wastage caused by overspray in other systems is saved. Overspray thus virtually eliminated, it is possible to spray large machinery units, carry out routine factory maintenance painting, etc., without troublesome special precautions. The operator needs no mask and the heavy ventilation of the water wash booth is unnecessary. Even spraying inside containers there is scarcely any rebound and health hazards are reduced.

Spray performance is controlled by selection of the nozzle, not adjustment on the gun. Taking control out of the hands of the individual operator and

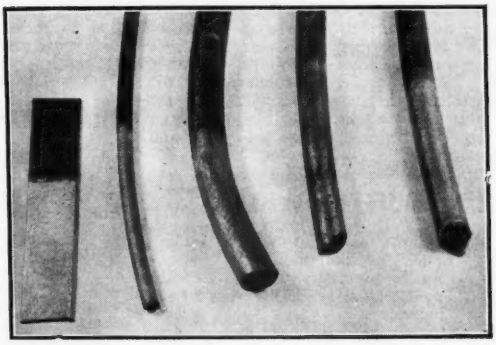
Left (below) The complete Bede airless spray system, showing the pumps, heater and gun. Right (below) *A large agricultural machine being sprayed without the usual precautions*



making it possible to form a uniform procedure for each type of finish, greatly reduces the risk of variation in quality, as it reduces the need for a highly-skilled operator. The nozzles are such that the paint can be spread in bands over 2 ft. wide. Up to 3 mil. can be deposited in one coat. The operator's efficiency seems to be the only check on the volume of paint that the gun can handle.

Users of airless spray in America have claimed that, because the paint particles hit the surface warm, they have better capillary action and adhesion is improved. Another asset is that the heated paint will disperse minute quantities of oil and grease.

Lacquers, synthetics, wrinkles and varnishes can be sprayed but some finishes present solvent balance problems. There has been, for example, little success so far with one-coat hammer finishes, as some lacquers show a tendency to pinhole unless proper balance is attained, but better results are expected as chemists gain experience in formulating for the process.



Steel stock oxidised and coated with heat and rolling scale; part of each is cleaned. Note how cleaning reveals all surface indentations
(*Photo by courtesy of "The Oil Engineer and Gas Turbine"*)

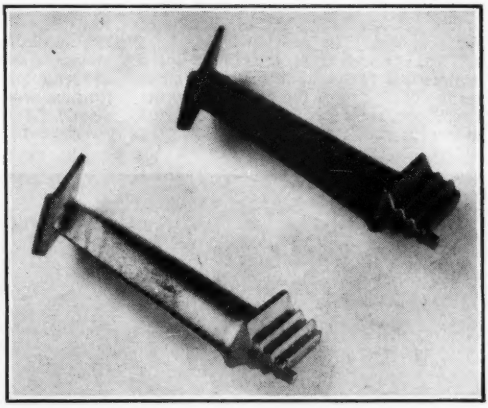
ALKALI DESCALING PROCESS

A NEW alkali descaling process has recently been developed by S. J. Patmore and Partners, 119 Station Road, London, N.W.4. Devised to act as a general cleaner and descaler of ferrous metals and aluminium alloys, the process for which patents are pending, allies thorough cleaning with speed and simplicity of operation.

The treatment is anodic-cathodic. Electrical consumption is 5 amps. D.C. per sq. ft. at approximately 3 volts. The rating remains practically constant in spite of changes in the area of the article to be cleaned, because of the low resistance of the solution. After treatment in the alkaline bath, articles are dipped into a mild acid neutraliser and any embrittling tendency is avoided.

The process removes grease, dirt, oxide layers, scale and carbon deposits. It can be used as a preparatory process to surface coating, such as painting, vitreous enamelling or plating, but, if used purely as a cleaner, need not be followed by any other treatment. Treatment times for the heavily scaled demonstration pieces observed by the writer rarely exceeding 6 minutes.

A small portable bath can be used for small components, and such articles as nuts and bolts can be effectively



Identical G.T. blades illustrate how erosion is shown up after cleaning
(*Photo by courtesy of "The Oil Engine and Gas Turbine"*)

barrelled in the bath. The process has the advantage of offering a means of cleaning large components—for example a gas turbine rotor—without dismantling.

Amongst the services offered by the firm are demonstrations arranged for interested persons, study of individual requirements and supply of plant and solutions.

NEW BUFFING WHEEL

AN improved metal-finishing buffing wheel, manufactured by Hanson-Van Winkle-Munning Co., of America, is claimed to cut faster and wear 30 per cent. longer.

Tested during regular production runs, the new buff practically eliminated break-in time. It was found that no rejects were turned out by the new buff after 5 min. break-in, where conventional buffs frequently took a half-hour to break in.

The new buff is impregnated with the same organic material that is used as a binder in buffing compounds. Forming a natural bond between buff and cutting compound, the impregnated "binder" permits thread ends to retain the compound more easily, more quickly and in larger quantity. The more compound carried, the less frequently are additional applications required, and the faster the cut under all conditions.

Grease-like in nature, the binder also tends to make the buff softer and more flexible during operation. Laboratory tests show that constant flexing damages the cloth of conventional buffs in an area beginning 1 in. from the periphery, and the cloth becomes progressively weaker as the buff wears down. Tests also show that the softer impregnated buffs wear as well on the last inch as the first.

Helping to hold frictional heat down is the self-ventilating design feature of the new buff. The individual buffs have six holes punched in their fibre-board centres and twelve air channels stamped on the outer rim of the centres. During operations, air is force-circulated over the numerous ruffles of the buff.

Cloth used in these buffs is cut on the bias to prevent unravelling and to provide more area and better adherence for the cutting compound.

CHROMIUM PLATING ANODE

A NEW type of "Korant" chromium-plating anode has been introduced by W. Canning and Co. Ltd. Developed from the older type copper-cored anode, the new one utilises a highly conductive aluminium core, thus lightening the anode and providing a core resistant to corrosion should it come into contact with plating solution through mechanical damage to the lead.

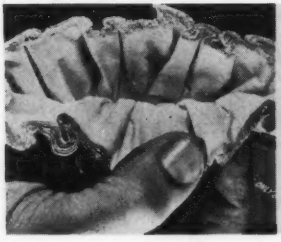
The new anode is produced in two types, the standard one being available for lengths up to 3 ft., and the light-weight triangular section model for lengths between 3 ft. and 6 ft.

RIGID P.V.C. SHEET

BAKELITE LTD. have published examples of some recent applications of their Vyback industrial rigid P.V.C. sheet, VR215.

The sheet is light and has very good resistance to chemical attack, especially from inorganic chemicals, good dimensional stability, low thermal conductivity and good ageing and electrical properties. It can be sawn, drilled, routed, milled, etc., and "hot gas" welded with matching rod. It may also be formed by heating above its softening point and then cooling in contact with the desired contour. Being thermoplastic it cannot be used unsupported above 60° C.

One example of its use illustrating its potential value to electro-platers was that at the printing works of the St. Clements Press, London, where it has been used to line an electroplating tank normally containing a solution of sulphuric acid and copper sulphate. Both welding and heat-forming around the edges have been employed on this job to ensure complete coverage of the older installation and



(Left) *The new treated buff compared with the untreated one on the right after the same period of wear*

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STOVES: INFRA-RED 3 - 4 MINUTES

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the result is a tank which will no longer cause any corrosion problem. So satisfied after a trial period are the firm with it, indeed, that a second tank is shortly to be treated in the same way.

As an alternative method of using the material, another London printing works, the Britannic Litho Co. Ltd. have by contrast installed new processing tanks for the development and preparation of lithographic negatives, built entirely from VR215. These are straightforward rectangular constructions in which the bottom and two of the sides are formed from single sheets in the case of one long tank, segments then being welded together—whilst the other two sides are again welded with matching rod.

Processing tanks at C.B. Litho Ltd. constructed from Vybak Industrial Rigid Sheet VR.215 supplied by Bakelite Limited

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Barrel Finishing Link-up.—Lacrinoid Products Ltd. have announced that arrangements have been completed with two other firms which will enable them to offer a complete service for the barrel finishing of metal parts. The firms concerned are: Carl Kurt Walter, Wuppertal, Germany, a barrelling machine manufacturer; and the Lord Chemical Corporation of Pennsylvania, a compound manufacturer. Lacrinoid themselves manufacture mineral oxide chips.

Institute of Metals, General Meeting.—A special general meeting of the Institute of Metals will take place on the 25th and 26th November, 1954, at 4 Grosvenor Gardens, London, S.W.1, for the discussion of scientific papers. The subjects of discussion will be: The Constitution of Titanium Alloys. 25th November, at 2.30 p.m.; Preferred Orientation, 26th November, at 10 a.m.; and Corrosion and staining of Aluminium Alloys, 26th November, at 2.30 p.m. Non-members will be welcome.

The Use of Titanium Oxide in Vitreous Enamels

SPECIALLY CONTRIBUTED

ALTHOUGH a patent was granted in 1893 covering the use of titanium oxide in vitreous enamels it was not until 1920 that TiO_2 became generally recognised as a beneficial ingredient in acid resisting enamels.

Research into the behaviour of TiO_2 in vitreous enamels led to the inception of the recrystallisation technique which facilitates the production of super opaque acid resistant enamels.[1] During the past 15 years the technique has become increasingly popular and today nearly all white and pastel shade enamels for holloware, etc., are dependent upon TiO_2 for their opacity, acid resistance and superior mechanical properties. Apart from this specific application TiO_2 is an important ingredient in most high quality enamels for cast iron and aluminium, etc.

Development of Manufacture of Titanium Oxide

Titanium oxide is an extremely powerful, non-toxic, white pigment of very fine particle size. It is manufactured in two crystal forms, anatase and rutile, the former being the type normally used in vitreous enamels. The two forms have the same chemical composition, TiO_2, but differ in crystal structure. In this connection, the use of the word rutile must not be confused with the mineral Rutile which, although containing a high percentage of TiO_2, is unsuitable for use in white vitreous enamels or for pigment manufacture.

The most important titanium ore is ilmenite, a black titaniferous mineral which comprises roughly 55 per cent. TiO_2, the remainder being largely FeO and Fe_2O_3 with small amounts of silica, magnesium, manganese, chromium, phosphorus, zirconium, vanadium and often traces of rare earths.

The sulphuric acid process of extracting titanium oxides from ilmenite was in use both in Norway and in North America in 1918 and much the same process is, with modifications, still in use today.

The information contained in this article has been made available to us by British Titan Products Co. Ltd., whose assistance we wish to acknowledge.

Manufacture of Titanium Oxide

The ilmenite is dried and finely ground, then digested with concentrated sulphuric acid—a violent reaction which results in a solid cake of mixed titanium and iron sulphates. This cake is dissolved in water and, after clarification, the resulting liquor—titanium sulphate— is cooled, whereupon some of the iron sulphate crystallises out yielding an important by-product—green copperas, which, incidentally, is used in the preparation of iron oxide colours, fertilisers and in effluent clarification. The titanium sulphate is separated from the copperas and hydrolysed. Next, the complex hydrated oxide is filtered and washed. Finally, the washed pulp is calcined and ground to give pigmentary titanium oxide.

Properties of Titanium Oxide Anatase E and HR for Vitreous Enamels

Crystal structure Anatase; Mean particle dia. ca. 0·2μ; Residue on 325 mesh 0·05 per cent. max.; Mean Refractive index 2·55; Specific gravity 3·9.

Typical Analysis: TiO_2 98·5; ZnO 0·02; Al_2O_3 0·10; P_2O_5 0·4; Soluble salts 0·4; Moisture 0·4; FeO 50 ppm.

Advantages of TiO_2 Self Opacified Enamels

In properly formulated enamels, the high refractive index of TiO_2, together with its small particle size on recrystallisation, gives complete opacity in one coat at an application weight of about 25 gm./sq. ft., dried slip over the conventional cobalt bearing groundcoat. This thin coat has superior thermal and mechanical shock resistance when compared with tin or antimony oxide opacified enamels which need to be about three times as thick to give equivalent opacity. The reflectance of self-opacified titania enamels is 80 per cent. or higher, and the tone can be varied from a blue white to a cream white at will.[2] (See Fig. 1).

Another advantage of TiO_2 is that its incorporation into an enamel considerably increases the acid resistance of the finish without unduly affecting its viscosity, smelting or firing temperature. The scratch resistance is also superior to that of the older finishes.[3]

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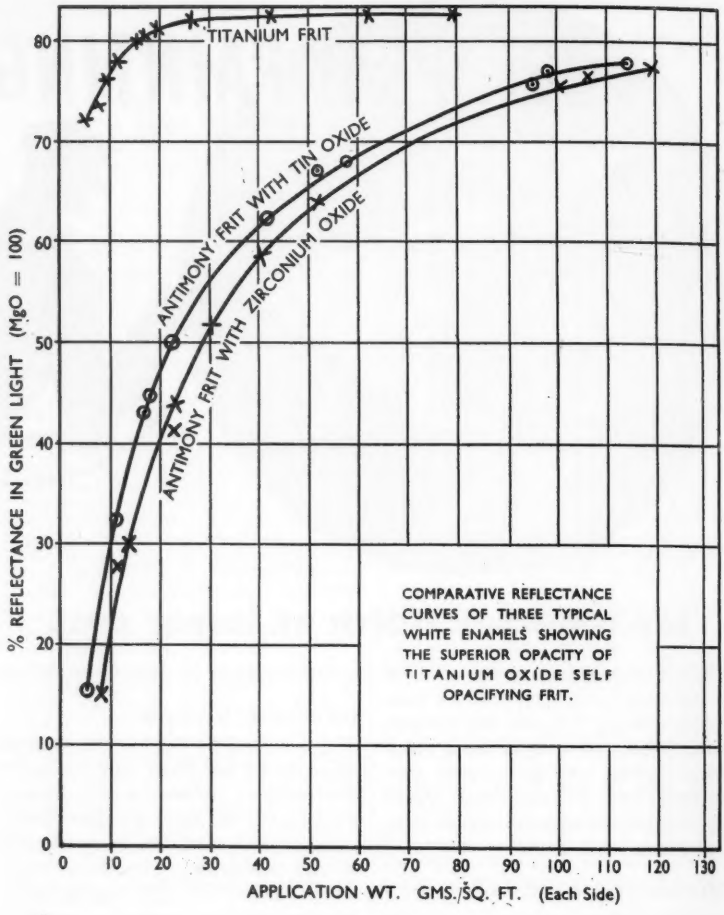
TITANIUM FRIT
ANTIMONY FRIT WITH TIN OXIDE
ANTIMONY FRIT WITH ZIRCONIUM OXIDE
% REFLECTANCE IN GREEN LIGHT (MgO = 100)
APPLICATION WT. GMS./SQ. FT. (Each Side)
COMPARATIVE REFLECTANCE CURVES OF THREE TYPICAL WHITE ENAMELS SHOWING THE SUPERIOR OPACITY OF TITANIUM OXIDE SELF OPACIFYING FRIT.

Fig. 1

Two of the early difficulties associated with the use of TiO_2 in steel enamels were:

(a) The expansion of enamels formulated to give the best colour and brightness was too small and distortion of the ware frequently occurred.

(b) When used with colouring oxides at the mill the fired colour varied from batch to batch, i.e., the enamels were critical of firing conditions.

The first of these disadvantages has been eliminated by the incorporation of lithium[4] and by adjustments to the enamel composition.[5] The second has also been overcome by ensuring that the recrystallised TiO_2 is in the anatase modification,[6] by incorporating phosphates in the batch[7] and by keeping the firing time/temperature at a minimum.

Mechanism of Self-opacification

The enamel composition is so formulated that all the TiO_2 dissolves in the rest of the glass during the smelting operation which is carried out at about 1,200° C. The batch-free smelt is then quenched in water to yield a pale coloured frit. The

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LEEDS, 12:	37 Oldfield Lane, Wortley	Tel.: Leeds 37365
MANCHESTER, 15:	22/28 Chester Road	Tel.: Blackfriars 1593

TABLE 1.

Mill Addition (per cent. on frit)

Frit number	*2155*	*231*	*M9*	*1033*	*814*	*1536*
Pipe clay	5	5	5	—	5	3
Bentonite	½	—	¼	—	—	½
Sodium aluminate	¼	¼	¼	—	¼	—
Potassium nitrate	¼	¼	¼	—	¼	—
Colour oxide	—	0-5	—	0-5	—	—
Titanium oxide	0-2	—	—	—	5	—
Black oxide	—	—	—	—	—	4
Borax	—	—	—	—	—	½

quenching operation is primarily to maintain the TiO_2 in supersaturated solution, but it does also facilitate subsequent milling of the frit. When the frit is reheated at the lower firing temperature (ca. 800° C.) only a portion of the TiO_2 remains dissolved in the glass; the rest crystallises out as small discrete particles. It is this recrystallised titania which provides opacity whilst the acid resistance is primarily determined by the TiO_2 remaining in solution in the glass.

The crystals of titanium oxide may be anatase or rutile or a mixture of the two and the crystal form is determined by the frit composition, which, together with the firing time/temperature, also fixes the size of the TiO_2 and hence its opacifying power.

Factors Controlling the Form of the Recrystallised Titania

For the popular bright clean toned enamels having good colour stability to firing changes, the TiO_2 should be in the anatase modification. This is obtained by:

1. Keeping the alkalis at a minimum.
2. Increasing the silica or alumina and hence the viscosity.
3. Incorporating P_2O_5 in the batch—approximately 2 per cent. on the melted composition is usually sufficient.
4. Thorough mixing of the enamel batch to ensure homogeneous TiO_2 distribution throughout the batch.
5. Smelting and firing under non-reducing conditions. (If reducing conditions exist in the smelting process the frit will be dark brown in colour).
6. Smelting until it is completely batch free.
7. Quenching the frit rapidly and uniformly as soon as it is batch free, to prevent premature TiO_2 recrystallisation at this stage.
8. Firing for the minimum time/temperature consistent with satisfactory flow, gloss, etc.

A formulation which yields a bright, white, colour stable, self-opacified enamel for use on sheet iron and steel is frit 2155.

General Notes on Mill Additions

The recommended mill additions† for titanium self-opacified enamels are:

1. *Suspending Agents*

3 to 6 per cent. pipe clay alone or in conjunction with 0 to ½ per cent. bentonite.

2. *Colour and Brightness Improvers*

¼ per cent. potassium nitrate, ½ magnesium carbonate, ¼ to ½ per cent. sodium aluminate, 1 to 2 per cent. titanium oxide.

3. *Electrolyte*

Any of the usual electrolytes may be used to "set-up" the slip, e.g., sodium nitrate, borax, potassium chloride, etc.

Other mill additions[8] such as urea, methyl cellulose, gum arabic, etc., have also been described and are useful to a limited extent as suspending agents or to improve biscuit strength. The use of a sodium silicate/sodium aluminate gel to suspend the frit has been patented.[9]

4. *Fineness of Grind*

The opacity of titania self-opacified enamels is practically unaffected by the degree of grinding of the slip although the extremes should be avoided, very coarse grinding resulting in an uneven surface and very fine grinding tending to cause tearing. Satisfactory limits are between 10 per cent. residue on 180 mesh to 1 per cent. on 325 mesh.

† *See Table* 1 *for per cent. on frit mill additions.*

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For Hot Cleaning of Steel, Brass, Copper, Britannia Metal, Tin and its alloys, Zinc and Aluminium.

A specially compounded Salt or Hot Alkali Cleaning of Steel, Brass, Zinc and Aluminium. Can be employed with, or without, Electric Current, except for Aluminium.

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An extremely efficient Cold Cleaner Salt used for the final cleaning of Steel, Brass, Copper and Copper Nickel Alloys immediately prior to plating.

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Application Weight

The graph of application weight of a typical TiO_2 self-opacified enamel, against brightness and colour index (Fig. 2), shows that the optimum results are given by an application of 25 to 30 gm./sq. ft. dried slip. Excessive amounts can cause a decrease in thermal and mechanical shock resistance.

Effect on Frit Constituents on the Properties of Self-Opacifying Titanium Enamels

1. *Increase in Alkali* (Na_2O, K_2O, Li_2O)
Increases expansion and workability but decreases acid resistance, brightness and anatase content. The colour becomes more cream and a lower firing temperature is possible.

2. *Increase in Silica*
The anatase content, blue tone, acid resistance and viscosity increase and the coefficient of expansion decreases. A high firing temperature is usually required.

3. *Increase in Boric Oxide*
Acid resistance, coefficient of expansion and opacity decrease. There is little effect on anatase content. At upper limit of B_2O_3 content the gloss deteriorates.

4. *Increase in Alumina*
There is little change in anatase content. The expansion increases and the gloss decreases. The solubility of TiO_2 in the frit decreases, i.e., more recrystallises on firing.

5. *Calcium Oxide or Fluoride*
These compounds have a deleterious effect on colour.

6. *Antimony Oxide*
The colour is adversely affected—a dirty green tone being formed.

7. *Fluorine*
As the fluorine content decreases so the brightness and acid resistance increase. Working properties are improved by incorporating fluorides.

8 *Zinc Oxide; Magnesium Oxide*
These oxides improve the brightness of the fired enamel and also decrease the blue tone. MgO is more effective in this respect than ZnO.

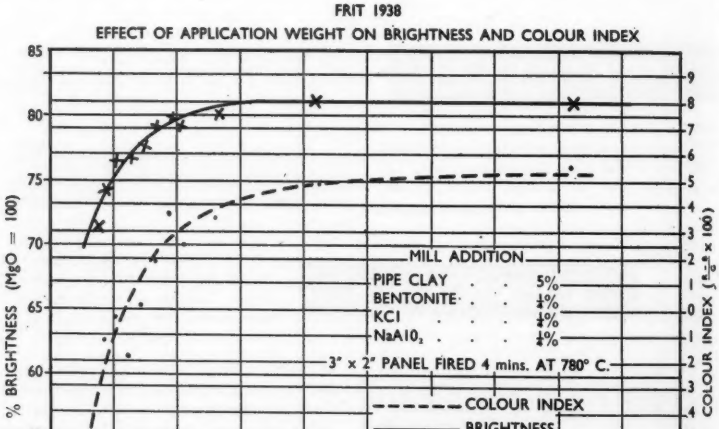
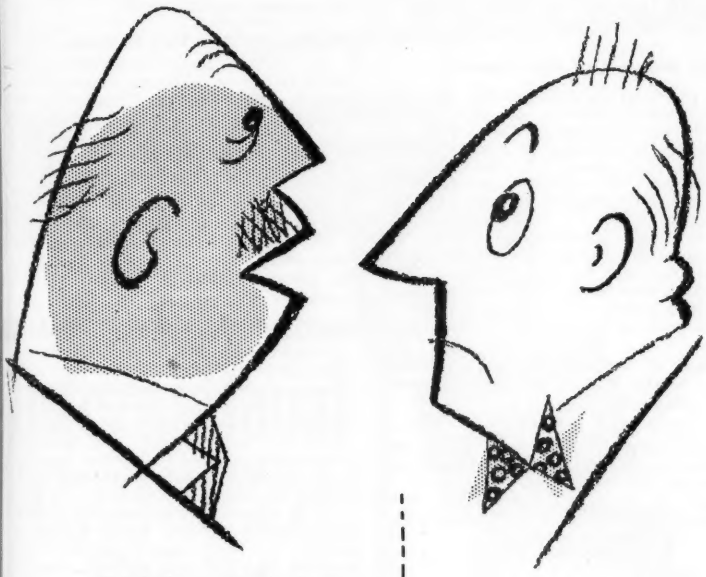

FRIT 1938
EFFECT OF APPLICATION WEIGHT ON BRIGHTNESS AND COLOUR INDEX
% BRIGHTNESS (MgO = 100)
COLOUR INDEX (L/a+b x 100)
MILL ADDITION
PIPE CLAY . . 5%
BENTONITE . . ½%
KCl . . . ½%
NaAlO2 . . . ½%
3" x 2" PANEL FIRED 4 mins. AT 780° C.
COLOUR INDEX
BRIGHTNESS
APPLICATION WEIGHT. GMS./SQ. FT. DRIED SLIP (Each Side)

Fig. 2



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9. *Phosphorus Pentoxide*
The anatase content and blue tone increase on incorporating P_2O_5. The colour stability to firing changes is improved.

Dry Process Cast Iron Enamels

Titania is incorporated into this class of enamel primarily to improve acid resistance although the expansion coefficient is increased by a partial silica/titania replacement. The opacity is often provided by antimony oxide which remains undissolved in the smelting process.

Frit 1033 is an example of an acid resisting dry process enamel. This type of frit must not be oversmelted or overfired otherwise a serious decrease in opacity occurs. As with steel enamels, a non-reducing atmosphere is required.

Effect of Variation in the Composition of Dry Process Antimony/Titanium Enamels

1. *Alkali*
An increase lowers the smelting and firing temperature but acid resistance and opacity decrease. The replacement of Na_2O by K_2O or Li_2O gives a more neutral white. The expansion increases on increasing the alkali content.

2. *Silica*
Decreasing the silica softens the enamel but the tone becomes creamier and the acid resistance decreases. The expansion increases.

3. *Fluorine*
Fluorine must be present in this type of frit to ensure good colour and gloss, but excessive amounts have a deleterious effect on acid resistance.

4. *Boric Oxide*
As the B_2O_3 increases so the fired enamel becomes whiter and brighter but gloss deteriorates. Acid resistance and expansion also decrease. Enamels low in B_2O_3 are prone to boiling troubles.

5. *Titanium Oxide*
For good opacity the optimum Sb_2O_3/TiO_2 ratio appears to be 1/2. Higher TiO_2 contents cause opacity to decrease and the cream tone to increase. Acid resistance is proportional to TiO_2 provided the other ingredients are unchanged.

6. *Antimony Oxide*
Increasing the Sb_2O_3 increases the opacity and has little effect on tone.

7. *Lead Oxide*
This ingredient lowers the firing temperature but induces a cream tone.

8. *Barium Oxide*
The omission of barium from the formula causes a decrease in opacity and an increase in cream tone.

Wet Process Cast Iron Enamels

This class of enamel is usually of the Sb_2O_3/TiO_2 type although investigations are proceeding into the utilisation of the self-opacifying TiO_2 enamels. These wet process finishes are similar in composition to those applied by the dry process in that the titania is present primarily to ensure acid resistance, the opacity being obtained from the antimony oxide with perhaps additional opacifiers at the mill.

The effect of frit ingredient on brightness, tone, corrosion, resistance, etc., is the same as given for the dry process enamels.

Titanium Oxide in Coloured Enamels

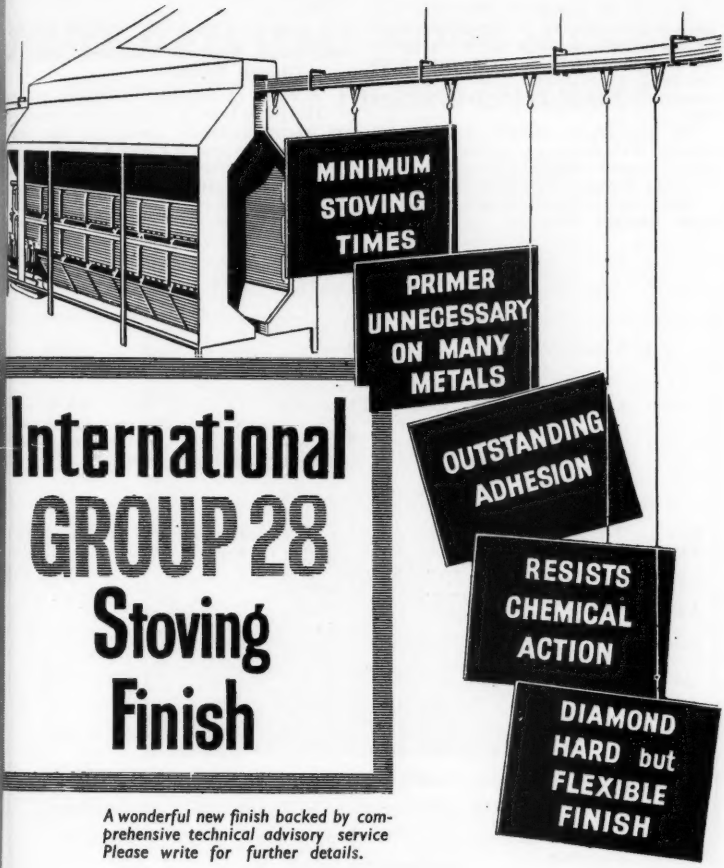
Ceramic colouring oxides may be incorporated into titanium bearing, acid resisting enamels to produce pastel shades or quite strong deep colours. Frit 2155 is a suitable base for stable pastel shades whilst frit 231—a clear acid resistant sheet steel enamel is suitable for the deeper colours. Recent unpublished work carried out at British Titan Products Co. Ltd., on self-coloured enamels has shown that pleasing colours having good stability to firing changes result from smelting in a frit such as 2155, various colouring oxides. Suitable oxides are those of copper, nickel, manganese, cobalt, chromium, etc., or mixtures of such elements. Published information on coloured titanium enamels is also available.[7, 10].

Factors influencing the change in colour by variations in firing conditions include anatase/rutile transformation, crystal growth, chemical reaction between the TiO_2 and the colour oxide, and the entry of colouring ions into the titania lattice causing a change in the valency state of the titanium with a resultant change in tone.

Super Acid Resistant Enamels for Chemical Plant

Enamels which must withstand corrosive chemicals approach the composition of glass, and such enamelled vessels are often called glass-lined. These enamels may contain up to 65 per cent. or 70 per cent. silica and this, together with the low content of alkaline fluxes, makes for an enamel of low expansion and fusibility. The use of titania as a partial replacement for silica overcomes these disadvantages in that there is no reduction in acid resistance but the enamel is more fluid and has a higher expansion.

Frit M.9 is a super acid resistant enamel of this type.



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Black Enamels

The use of titania in improving acid resistance is utilised in the formulation of many black enamels. The amount of TiO_2 incorporated is such that none recrystallises on firing. Frit 1536 is an example for application to sheet iron and steel.

As with white enamels, so it is with blacks, that variations in the frit composition cause change in tone as well as in acid resistance, expansion, etc.

The more common constituent variations together with the accompanying colour range may be listed as given in Table 3.

Specialised Uses of Titanium Oxide in Vitreous Enamels

1. *Enamels for Aluminium and its Alloys*

There has been a considerable amount of patent literature describing the formulation of vitreous enamels for application to aluminium and its alloys and in many of these formulæ titania has been incorporated to confer opacity and whiteness. The acid resistance of aluminium

TABLE 2.

Frit Formulation.

Frit Number	2155	231	M9	1033	814	1536
Type of Enamel	Super opaque white for sheet iron/steel	Clear AR steel enamel	Super AR for chemical plant	Dry process AR cast iron	Wet process cast iron	AR black for sheet iron/steel
Smelting Temp. ° *C.*	1200+	1100-1200	1150-1200	1050-1100	1050-1100	1100-1150
Firing Temp. ° *C.*	820-840	800-850	850	800	740	820
Batch Compostion						
Feispar	9·2	28·0				
Borax (hydrated)	24·1	22·0	2·6	24·0	14·2	21·9
Quartz	33·4	25·0	19·2	29·4	37·6	37·8
Titanium oxide	15·6	8·5	15·3	10·2	7·8	9·9
Cryolite	2·7				7·9	
Potassium nitrate	9·3			8·2	4·8	10·9
Zinc oxide	1·0			2·0		
Magnesium carbonate	0·7					
*Pot. monohydrogen phosphate	4·0					
Sodium silicate			51·3			
Sodium aluminate			5·3			
Whiting			2·2			
Fluorspar			3·0	3·8		
Soda ash		6·5		5·5	8·6	4·4
Sodium nitrate		7·0	1·1	8·0	9·1	6·5
Calcium carbonate					4·6	
Antimony oxide				5·1	5·4	
Sodium silico fluoride		3·0				3·6
Black cobalt oxide						0·7
Manganese dioxide						1·4
Chrome iron ore						2·9
Barium carbonate				3·8		
Total	100·0	100·0	100·0	100·0	100·0	100·0

**This K_2HPO_4 can be replaced by a sodium or ammonium phosphate on an equal P_2O_5 basis, making due allowances for the potassium and sodium contents.*

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TABLE 3.

Alteration to batch	*Colour change*	*Effect on Acid Resistance*
increase Na_2O	Darkens considerably	Deterioration
„ K_2O	Darkens	„
„ F_2	Negligible effect	„
„ B_2O_3	Turns bluer and lighter	„
Decrease SiO_2	Slight darkening	„
„ B_2O_3	Considerable darkening	Improvement
Replace some Na_2O by K_2O	Slight lightening	Little effect
„ „ K_2O by Na_2O	Slight darkening	„
„ „ SiO_2 by TiO_2	Slight darkening	Slight improvement
„ „ TiO_2 by SiO_2	Slight lightening	Slight deterioration
Increase CoO	Increases blue tone	Negligible
„ MnO_2	Increases pinkish tone	„
„ Fe_2O_3	Increases brown tone	„
„ Cr_2O_3	Increases brown green tone	„

enamels is usually poor because of the large amount of flux required to enable the enamel to fire out below the softening point of the base.

B.P. 580, 688 quotes a suitable formula as:

Red Lead	20·8
Silica	27·1
Sodium Carbonate	16·2
Lithium Carbonate ...	5·7
Potassium Carbonate ...	12·5
Boric Acid	8·3
Titanium Oxide	9·4
	100·0

2. *Zinc Titanate Enamels*

This class of finish has quite good opacity and brightness but is deficient in acid resistance. As the name suggests, the actual opacifier is a combination of zinc oxide and titanium oxide, 15 to 20 per cent. of each being present in the batch composition. One advantage of this type of enamel is that it possesses good colour stability to changes in firing time/temperature because of the absence of any anatase/rutile transformation.

3. *Borax Substitute*

During the war a sodium titano-silicate (V.26) was developed in Germany to replace borax as an enamel ingredient. Although good results were claimed it is doubted whether they were up to the standard of the corresponding borax containing frits. According to B.I.O.S. final report No. 944, Item 22, V.26 was made by smelting the following batch at 1,050° C., drying and grinding:

Quartz	22·0
Soda Ash	39·7
Titanium Oxide	31·0
Fluorspar	3·0
Sodium Nitrate	2·3
Sodium Silico Fluoride ...	2·0
	100·0

It is known that sodium titano-silicate is a very mobile liquid at the smelting temperature and it is this fact which is utilised when titania is incorporated into an enamel to improve the acid resistance without the attendant viscosity increase which would result from a similar increase in the silica content of the frit.

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4. S. Hallsworth, *A Study of the Use of Lithium in Vitreous Enamels*. I.V.E. Bulletin, April, 1951.
5. A. L. Friedberg, F. A. Petersen, A. I. Andrews, *Effect of Composition on Colour of Titanium Enamels, J. Amer. Cer. Soc.*, 30(9) 261-77 (1947).
6. N. S. C. Millar, *Factors Affecting the Colour of Titanium Enamels*. Sheet Metal Industries, Dec., 1949.
7. B. K. Niklewski, R. H. Ashby, *Stability of Colours in Titania—Opacified Enamels*. I.V.E. Bulletin.
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9. *B.P.*564, 597, S. G. Tinsley.
10. N. K. Russell, A. L. Friedberg, F. A. Petersen, *Colour Stability of Clear and Opaque Titania Enamels containing Various Colour Oxides, J. Amer. Cer. Soc.*, Vol. 34, No. 1, p. 28, 1951.

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Acid Resisting Cement. Employed for bedding and joining of vitrified bricks and tiles in the construction of acid resisting floors, walls and tanks. Acid resisting cement is described in a four-page leaflet which explains uses and properties, gives directions for use and estimating. J. H. Sankey and Son Ltd., Refractories Works, Ilford, Essex. (131)

Chromium Plating Anode. Coloured brochure gives details of a new chromium plating anode which utilises a highly conductive aluminium core, thus lightening the anode and providing a corrosion resistant core. The anode is produced in two types, the standard one being available for lengths up to 3 ft., and the lightweight triangular section model for lengths between 3 ft. and 6 ft. W. Canning and Co. Ltd., Birmingham 18. (132)

Air Filters. Illustrated brochure provides information on air filters designed to remove corrosive moisture and foreign matter from compressed air lines ¾ in. and 1 in., and ½ in. and ¾ in. pipe sizes. The filters for the former pipe sizes have a recommended flow of from 0 to 140 cfm., the latter from 0 to 30 cfm. Both

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Hardness Testing Machines. Illustrated booklets give details of two direct hardness testing machines. One powered with a built-in unit, measures the depth of the Brinell impression. The method used is claimed to largely eliminate the effect of surface roughness, and readings can be taken on surfaces produced by shot or sand-blasting. The second hand-operated machine is designed specifically to carry out the Rockwell test using a hardened steel ball or diamond cone penetrator. This test is extensively used as a comparative test in production processes with the Brinell test as a laboratory, reference for control. W. and T. Avery Ltd., Soho Foundry, Birmingham 40. (134)

Gold Plating and Colour Gilding. A 16-page booklet contains articles on Gold Plating and Colour Gilding, Technical information is supplied on the products necessary for these processes together with brief notes of services offered by the firm in the treatment of electro-plating residues and analysis. Johnson and Matthey Ltd., Hatton Garden, London, E.C.1. (135)

Strippable Plastic Coating, Anti-Corrosive Paints. Pamphlet gives details of a hot-dip, strippable, plastic coating which provides both a corrosion preventive and packing medium for finely finished parts, etc. The skin is removed by slitting open when it peels away leaving a film of lubricating oil exuded during storage. Another pamphlet lists priming and finishing anti-corrosive paints for steel-work made by the same firm. Croda Ltd., Croda House, Snaith, Goole, Yorks. (136)

Automatic Chromium Plating Barrel. A coloured, illustrated brochure supplies information on an automatic chromium plating barrel designed to meet a demand for the automatic chromium plating of small articles such as nuts and bolts which have first been nickel plated. Articles up to 2 in. in length can be plated without nesting. Sole manual operations are filling the hopper with articles for plating and removing baskets of plated articles. Dimensions are approximately 6 ft. 0 in. long by 3 ft. 9 in. wide by 7 ft. 0 in. high (to fan outlet); net weight is 20 cwt. Electro-Chemical Engineering Co. Ltd., Netherby, Queens Road, Weybridge, Surrey. (137)

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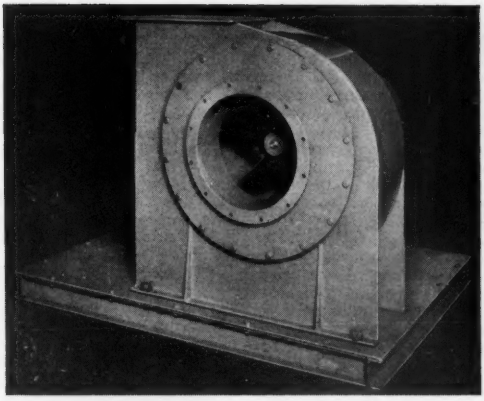

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Improved Priming Technique Yields High Bonding Strength to Corrosion-Inhibiting Finishes on Metallic Surfaces.—By means of an improved priming technique, corrosion-inhibiting finishes are being applied with a pneumatic spray to various metallic surfaces with unusually high bonding strength at Consolidated Vultee Aircraft Corporation, San Diego, California. This technique involves the preliminary use of a thermosetting wash primer, over which a vinyl zinc chromate seal primer or cover coat is applied.

Aluminium aircraft parts are prepared for the priming operations by anodising, alodising, and chromatising in the conventional manner. Magnesium parts are either anodised or dichromated, while steel components may be electroplated, sand blasted, or pickled.

The wash primer is prepared by slowly adding one part by volume of acid catalyst to four parts by volume of a thoroughly mixed thermosetting resin component, and stirring until the acid is completely dispersed in the resin. Then isopropyl alcohol is used to thin (about one part by volume being required to thin one or two parts resin in ordinary circumstances). When properly thinned, the wash primer can be applied with pneumatic spray equipment at temperatures of from 40 to 90°F., if the relative humidity does not exceed 90 per cent.

Special precautions are being taken in preparing and labelling mixed batches of wash primer, because the thermosetting resin cannot be safely applied or replenished with freshly mixed materials more than 8 hours after it is initially catalysed.

The spray equipment is cleaned with an alkaline solution prior to using the wash primer, and deposition surfaces are inspected to make sure they are perfectly dry. Then the wash primer is applied so that it will become a protective film with a maximum thickness of 0·0005 in. after 1 hour of drying time at room temperature.

The vinyl primer must be applied over the wash primer as soon as possible after the latter is dry, because small quantities of moisture (due to fog, rain or high humidity) can readily permeate the wash primer if it is not shielded with a secondary medium. The wash primer will begin to oxidise and lose bond strength about 5 hours after it is dry, if it is continuously exposed to open air.

Where a vinyl primer cannot be applied within 5 hours, or prior to the exposure of the wash primer to moisture, parts must be stripped and completely re-treated.

The vinyl primer is also normally applied with spray equipment, and parts will dry sufficiently at room temperature to be handled in 30 min.

Dry film thickness of the vinyl primer coat may range from 0·007 in. to 0·001 in. If the coating is scratched or otherwise damaged in handling and assembly operations, repairs are made in the following manner:

1. Damaged areas are faired with No. 280 (or finer) wet or dry sandpaper.
2. Faired areas are carefully cleaned with cheesecloth soaked in naphtha.
3. Cleaned areas are brush-anodised and wash-primed as necessary.
4. Vinyl primer is applied over the the repair area and over about 1 in. of the adjacent, previously applied primer film.

Parts thus primed and/or repaired are usually date-stamped so that they can be inspected in not less than 24 hours after the initial drying interval.

Batch specimens of primed parts are knife tested to ascertain the qualities of applied coating materials; remaining components are tested by using cellulose tape to determine whether the primer coatings meet minimum requirements with reference to adhesion.

Following inspection, primed parts are assembled and then enamelled where decorative effects or special functions require.

(*Products Finishing*, December, 1953.)

Change of Address.—The Cardiff office of Babcock and Wilcox, formerly at 102 St. Mary's Road, is now at 26 High Street, Cardiff. The new telephone number is Cardiff 29366.

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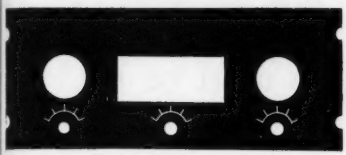

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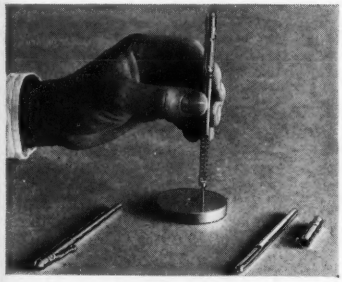

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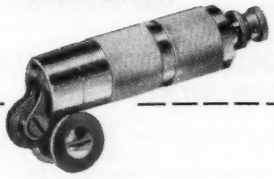

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CORROSION PROBLEMS IN EUROPE

A STUDY of anti-corrosion methods has been carried out by European experts at meetings organised by the O.E.E.C. during the twenty-seventh International Congress of Industrial Chemistry recently held in Brussels.

These meetings, which were presided over by M. Roger de Smet, director of the Belgian Chemical Union, brought together European executives who had taken part in a study mission to the United States, arranged under the O.E.E.C. Technical Assistance Programme, during the summer of 1953. Together with a number of specialists on corrosion problems, they were thus provided an opportunity for studying the various technical and economic aspects of this phenomenon, whose importance is often under-estimated in Europe. In the United States, annual losses from corrosion are estimated at between five-and-a-half and six thousand million dollars, and involve the destruction of more than 2 per cent. of total steel tonnage.

The experts discussed the report of the Study Mission which dealt with "Corrosion problems and prevention in the Chemical and Petro-Chemical Industries in the United States," and studied its conclusions on protection techniques and anti-corrosion materials. They were unanimously in favour of the report's recommendation that a European association which would group all corrosion specialists and would become a centre for exchange of information should be set up as speedily as possible. An association of this nature, the National Association of Corrosion Engineers, already exists in the United States, and renders invaluable service in co-ordinating work on anti-corrosion methods.

EPOXIDE RESINS PATENT AGREEMENT

AN agreement has been reached reached between Aero Research Ltd. and Shell Chemicals Ltd. covering, in the United Kingdom, the patents held by Ciba and Shell in the field of epoxide resins.

This agreement gives freedom under both the Ciba and Shell patents to all purchasers of epoxide resins from either company to sell or use these materials in the surface coating field.

In the specialised fields of potting, casting, laminating and adhesives, similar freedom under the patents will be available to customers purchasing epoxide resins from either company for their own use but not for resale in their original or modified form.

ATLAS DIESEL CO. LTD.

THE ATLAS DIESEL CO. LTD. are exhibiting their products on two stands at the Public Works Exhibition, Olympia.

The main stand, No. 33, has a comprehensive range of equipment including stationary and portable compressors, mining and drilling equipment, loaders, rammers, pile drivers, rock drills, concrete breakers, clay diggers, air hoists, and a representative selection of pneumatic tools and paint spraying equipment.

The gallery stand, No. 260, houses the exhibition offices and displays a comprehensive range of "Ecco" paint spraying equipment and engineers' pneumatic tools for workshop use.

Amongst new equipment on show, there is the "One-Ten" portable compressor, which embodies the Ford Industrial "cost-cuttter" diesel engine. This is a full two-tool unit with electric starting and voltage regulator. Also exhibited is the new KE-6MV compressor fitted with an Armstrong Siddeley air-cooled diesel engine. This is a compact and neat unit for the smaller jobs where the c.f.m. required is in the region of 35 per minute.

O.C.C.A. Technical Exhibition, 1955.—The Oil and Colour Chemists Association have announced that sixty-nine companies have been allocated stand space for the Technical Exhibition, 1955, a large increase over this year. The exhibition is to take place from the 15th to 16th March, 1955.

O.C.C.A., London Section.—A paper, "Changing Frontiers in the Analytical Chemistry of Paint Materials," by C. Whalley, is to be presented to the London Section of the Oil and Colour Chemists Association on the 15th December, 1954, at the Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, London, W.1, at 7 p.m.

Corrosion.—A paper, "Corrosion Prevention in the Telecommunications Industry," by C. E. Richards, is to be presented to the Corrosion Group of the Society of Chemical Industry on the 15th December, 1954, at the Chemical Society, Burlington House, Piccadilly, W.1, at 6.30 p.m.

Names in the News

Retirement

I. A. MACMILLAN TO RETIRE FROM SHELL CHEMICALS

AFTER twenty-seven years' service with the Shell Group, Mr. I. A. Macmillan, manager of Shell Chemicals' London Division, is to retire and settle in Jersey.

He will be succeeded by Mr. A. D. Buckland-Nicks, who is at present head of the Detergents Division of Chemical Industry Administration, the Shell Petroleum Co. Ltd.

Mr. I. A. Macmillan

Mr. Macmillan joined the Asiatic Petroleum Co. Ltd. in 1927 and was on the staff of their Fuel Oil Department until he joined the colours in 1940. He saw four-and-a-half years' service overseas in the Middle East and P.A.I. Force, and rose to the rank of Lt.-Colonel. Shortly after returning to the Shell Group after his demobilisation he became the first manager of London Division of Shell Chemicals Ltd.

Mr. A. D. Buckland Nicks

Mr. Nicks, who is at present in Canada and the U.S.A. on Shell's chemical business, joined the Shell Petroleum Co.'s Technical Products Department on leaving Berkhamstead School in 1939, but within three months was serving with a Middlesex unit of the Royal Artillery. He saw service in France and Germany, and was demobilised with the rank of Major in March, 1946, rejoining Shell shortly afterwards. He has been largely responsible for the rapid development of Shell's detergents in overseas markets since the war.

Appointments

K. J. R. McDONALD

WALTER CARSON AND SONS LTD., have announced the appointment of Mr. K. J. R. McDonald to their sales staff as sales manager in charge of

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their architectural and specification department.

Mr. P. McQuade, who has now completed forty years' service with the company, continues as general sales manager responsible for over-all sales policy with Mr. W. S. O. Wright as sales manager, wholesale sales.

Mr. McDonald, who is 44, was educated at Cheltenham College and is already well known in the paint trade, having worked for International Paints Ltd., since 1938, and for the past four years has been London manager for their decorative division.

S. G. JONES

MR. STANLEY G. JONES, of the Marine Paints Division of Blundell, Spence and Co. Ltd.—who has been with the company since 1904—has just completed fifty years on the Baltic Mercantile and Shipping Exchange.

Recalling the days of the sailing ship, Mr. Jones remembers when Blundells used the sea route to transport their paint from the Hull works to the London depot. "During the first week I was with Blundells I asked the shipping company whose vessels were used why they did not use some of the paint they carried on their own ships. That was my first contract—and the humble beginnings of our Marine Paints Division."

In those days it was customary for ships to take on supplies of raw materials —white lead, white zinc, red lead and oil—and crews became their own paint manufacturers while at sea. They mixed the ingredients literally by hand.

J. E. ARNOLD

FOLLOWING the October meeting of the Oil and Colour Chemists' Association Council, J. E. Arnold, Ph.D., F.R.I.C., A.Inst.P., of the London Section, has been appointed as acting honorary secretary of the association.

Dr. Arnold was educated at University College, London, during the years 1934-39 and obtained a B.Sc. (Special) in chemistry in 1936. He was awarded a Ph.D. in physical chemistry in 1940. In the same year he was appointed as Research Chemist with Titanine Ltd. and was promoted to Chief Chemist and Technical Manager in 1946. Since November, 1950, he has served as Technical Director at Indestructible Paint Co. Ltd. and associate companies.

Dr. Arnold has published papers in the O.C.C.A. Journal and elsewhere, and has served on the Council of the Research Association of British Paint, Colour and Varnish Manufacturers.

C. J. Constant.—Mr. C. J. Constant has joined Aerostyle Ltd., as technical representative for the counties of Cheshire, Lancashire and Yorkshire, where he is well known.

C. H. Spence.—Mr. Charles H. Spence, O.B.E., sales manager of Bitulac Ltd., has been appointed a director. He has had thirty-three years' service with the company, which he joined on leaving school in 1921.

He is president of the Newcastle Royal Grammar School Old Boys' Association.

Bowaters Appointment.—Mr. K. T. Saxton, general manager of John J. Bowater Ltd., has been appointed to the Board of Directors.

Mr. Saxton joined Bowaters after the war as London manager. He was transferred to West Bromwich in January, 1953, when he became general manager of the company.

Bowaters is a subsidiary of Blundell, Spence and Co. Ltd.

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Council of Industrial Design.—Mr. Paul Riley, who has been chief information officer of the Council of Industrial Design since April, 1948, has been appointed Deputy Director in charge of the Industrial Division.

Mr. Reilly will be succeeded in the Information Division by Mr. J. Noel White, who has for the past six years been information officer of the Rural Industries Bureau.

Advisory Visit

MR. HARRY W. HOWARD

MR. HARRY W. HOWARD, who, as we mentioned in the October editorial, was in England last month to advise on Shell epoxide resins, and whose photograph is reproduced here, has had an interesting career in the field of industrial surface finishes.

Mr. Harry M. Howard

Mr. Howard is a graduate in chemical engineering, he first worked for the Egyptian Lacquer Manufacturing Co., New York, where he was responsible for the development of synthetic resin finishes. In 1939 he became Chief Chemist with the Beckwith Chandler Manufacturing Co., of Newark, New Jersey, and in 1942, was loaned to the Chemical Bureau of the War Production Board, soon being appointed Chief of the Petroleum Derivatives Unit and Administrator of Aromatic Solvents, Naphthenatic Acids and Chlorinated Paraffins.

After the war, and until he joined the Shell Corporation in 1949, Mr. Howard was technical assistant in the Resin Division of the United States Industrial Chemicals Company. As Supervisor of Surface Coating Resins in the Technical Service Laboratories with Shell he has addressed during the last five years nearly every paint production "club" in the U.S.A. and Canada, describing the properties and uses of epoxide resins.

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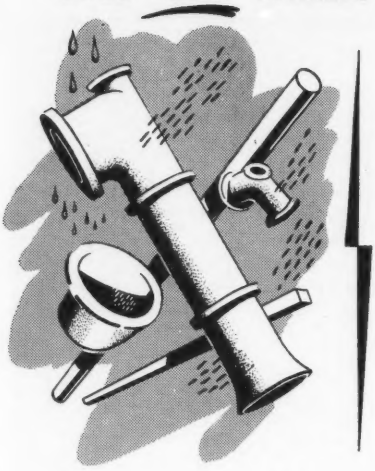

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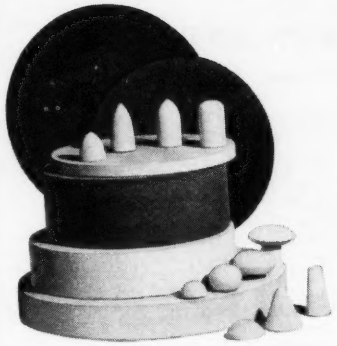

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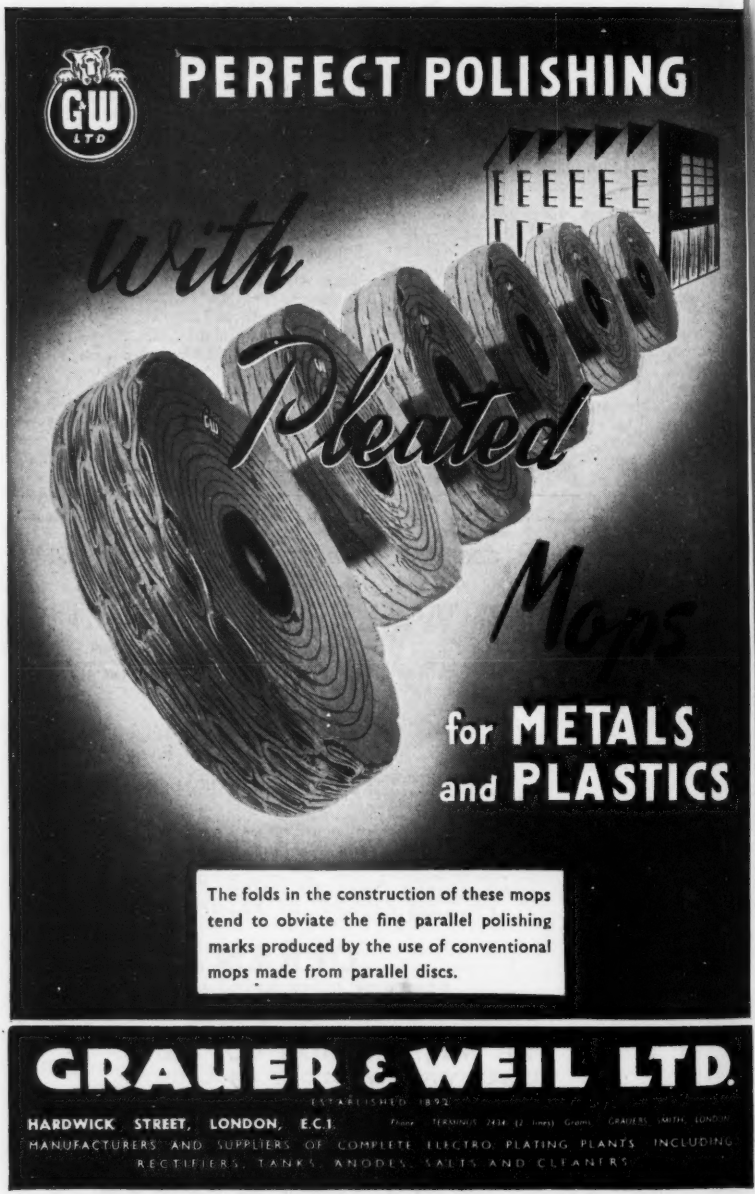
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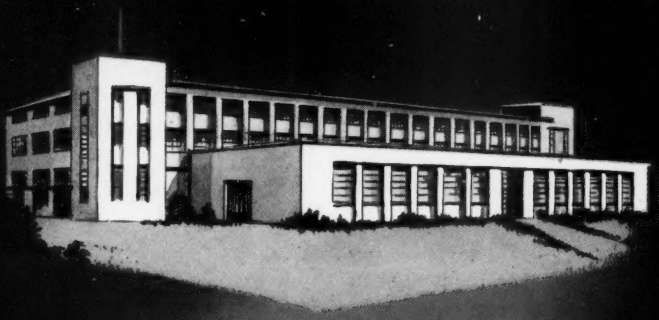

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